WATER & SEWAGE WORKS

Perchloron

REG. U. S. PAT. OFF.

When a water main breaks, and pollution enters, there's a sure way to safeguard the water supply . . . add Perchloron. Quickly soluble and stable, Perchloron retains its labeled strength over long periods. It is free-flowing, concentrated, always ready for instant emergency use.

Perchloron serves other water treatment functions too . . . sanitation of small water systems, new mains, wells, swimming pools. Its properties include the oxidation of ferrous iron in water, removal of hydrogen sulphide, control of most types of algae, and the destruction of chlorine-susceptible bacteria.

PENN SALT

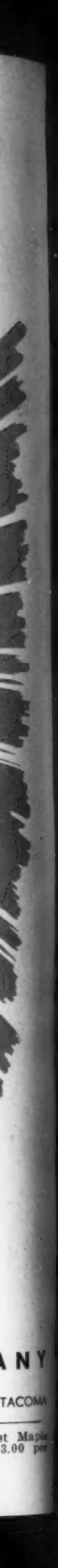
CHEMICALS

PENNSYLVANIA SALT MANUFACTURING COMPANY

1000 Widener Building, Philadelphia 7, Pa.

NEW YORK • CHICAGO • ST. LOUIS • PITTSBURGH • CINCINNATI • MINNEAPOLIS • WYANDOTTE • TACOMA

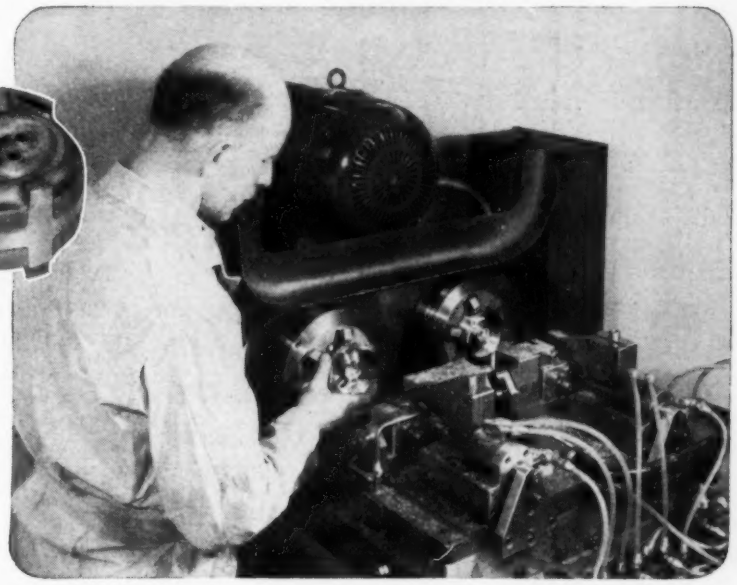
WATER AND SEWAGE WORKS. December, 1946, Volume 93, Number 12. Published monthly by Gillette Publishing Co., 22 West Maple St., Chicago 10, Ill. Per copy, 25c. Subscription rate, United States, $2.00 per year; Canada, $2.00 per year; Foreign, $3.00 per year. Entered as Second Class Matter, March 12, 1946, at the Post Office at Chicago, Ill., under act of March 3, 1879.



HOW *you* BENEFIT

FROM *NEW* PRECISION EQUIPMENT *in* EMPIRE *Oscillating Piston* METER MANUFACTURE

New, specially built automatic equipment for exacting dimensional control in Empire Meter manufacture is translated into immediate advantages for the user. Such care in production assures accurate, dependable meter operation year after year. It assures maximum revenue at minimum cost. It assures long-lived, close-registering meters—meters free from breakdowns, sticking and premature wear. Yes, precision in manufacture means precision in service, and today's Empire Meters are the most precise measuring instruments ever produced in the 62 year history of this design.



Mating parts of the Empire measuring chamber are internally finished on precision type automatic boring machines. Tolerances are rigidly held to within .0003" on the depths and .0005" on the diameter. Other equally accurate automatic machines finish turn the exterior surfaces of the measuring chamber and those of the balanced oscillating piston that operates within.

EMPIRE TYPE 12

Frost protected model with bronze case and breakable cast iron bottom plate.

PITTSBURGH EMPIRE *Water Meters*

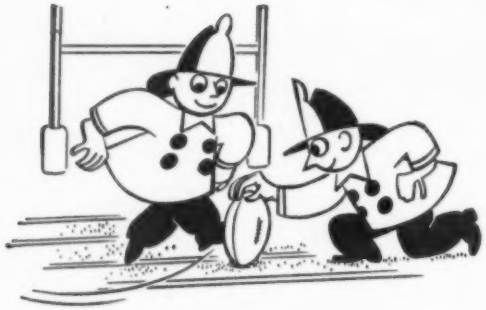
PITTSBURGH EQUITABLE METER DIVISION

ROCKWELL Manufacturing Company

Pittsburgh 8, Pa.

EMPIRE TYPE 14

All bronze model for use in warm climates.



TEAMMATES...and with Good Reason!

Fire and water departments the world over have a warm feeling for any Mathews Hydrant, and with good reason—it doesn't run out on the team. Weather makes no difference to it—it works in summer, when the going's easy; and it works the same, sure way in winter—which is what fire-fighters like about it, and have liked about it for generations.

All working parts are enclosed in a *removable* barrel, so designed as to be a perfect barrier against rain, snow, and hydrant water. A Mathews is not subjected to strain as the ground freezes, for its tough "Sand-Spun" protection case, free to move up and down, takes the thrust. If ever damaged, a Mathews can be back in service in no time—it's a matter of minutes to unscrew the barrel and replace it; besides, it's all an *above-pavement* job. The Mathews is a marvel of inventiveness; in fact, it is a mechanical triumph.

MATHEWS HYDRANTS

Made by **R. D. WOOD** *Company*

PUBLIC LEDGER BUILDING
INDEPENDENCE SQUARE, PHILADELPHIA 5, PA.

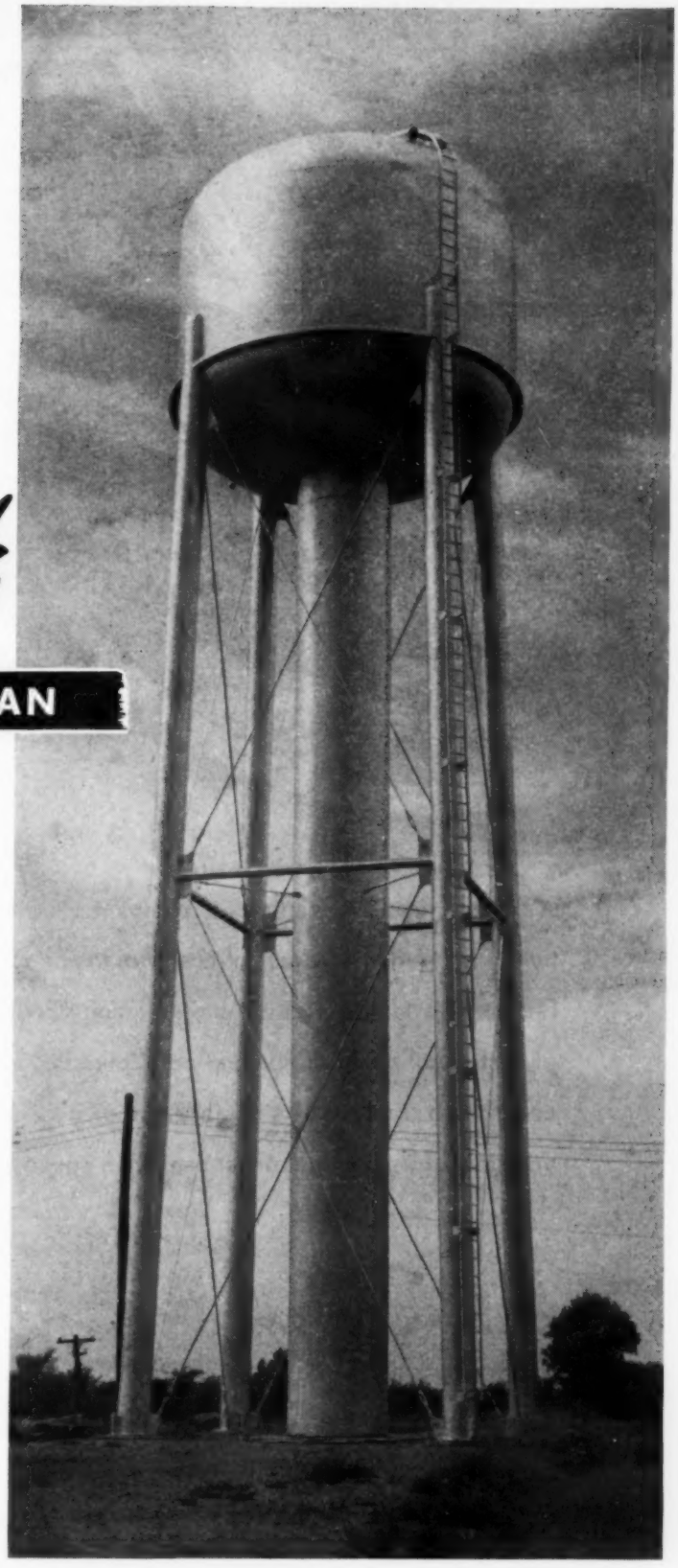
MANUFACTURERS OF SAND SPUN PIPE (CENTRIFUGALLY CAST IN SAND MOLDS) AND R. D. WOOD GATE VALVES

another *Horton tank*

for STAMBAUGH, MICHIGAN

In 1907 Chicago Bridge & Iron Company built a 45,000-gal. elevated tank to provide gravity pressure in the water distribution system at Stambaugh, Michigan. This tank has served the city for 39 years. A new Horton all-welded elevated tank has recently been erected to supplement the old tank in providing water pressure for the 600 customers in and around Stambaugh. A photo of this new tank is shown at the right. It holds 50,000 gals. and is 61 ft. 8 in. to the bottom. The riser on this tank is 6-ft. in diam. The tank is located in the approximate center of population about one mile from the pumping plant. A pressure of approximately 100 lbs. per sq. in. is maintained at the pumping plant.

Horton elevated water storage tanks are built in standard capacities to meet municipal requirements. Write our nearest office for quotations.



Engineering Data Regarding the Stambaugh, Michigan, Water Distribution System

★

Gallons in Elevated Storage—95,000.
Miles of Distribution Mains—17.
Size of Distribution Mains—4 in., 6 in., 8 in.
Miles of Transmission Mains—1.
Size of Transmission Mains—8 in.
Number of Meters—600
Number of Fire Hydrants—56.
Average Daily Consumption—145,000.

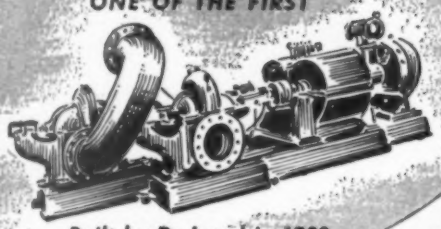
CHICAGO BRIDGE & IRON COMPANY

Chicago 4.....2198 McCormick Bldg.
New York 6.....3390-165 Broadway Bldg.
Cleveland 15.....2262 Guildhall Bldg.
Los Angeles 14.....1455 Wm. Fox Bldg.
Birmingham 1.....1586 North 50th St.
Atlanta 3.....2181 Healey Bldg.
Plants in Birmingham, Chicago and Greenville, Pa.

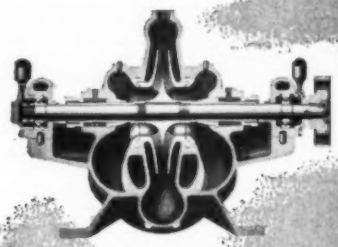
Tulsa 3.....1646 Hunt Bldg.
Houston 1.....5615 Clinton Dr.
Philadelphia 3.....1644-1700 Walnut St. Bldg.
Washington 4.....703 Atlantic Bldg.
San Francisco 11.....1283-22 Battery St. Bldg.
Detroit 26.....1551 Lafayette Bldg.
In Canada: Horton Steel Works, Limited, Fort Erie, Ont.

45 Years of PUMP IMPROVEMENT

ONE OF THE FIRST

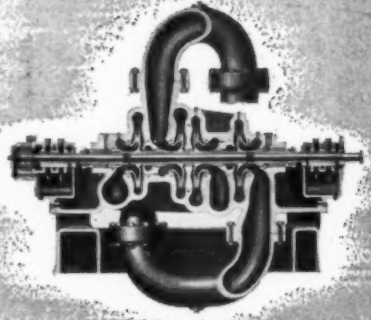


Built by De Laval in 1902

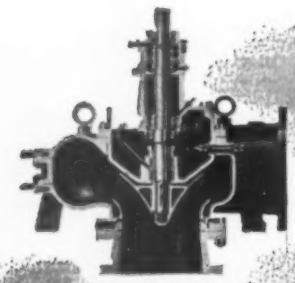


SINGLE STAGE, DOUBLE SUCTION PUMP

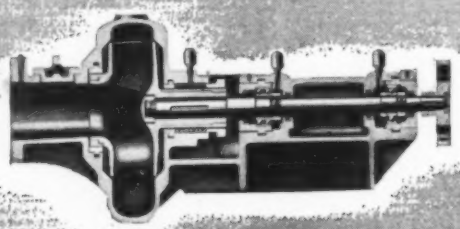
Modern De Laval centrifugal pumps represent the culmination of more than 45 years of continual improvement and perfection. This long period of concentration upon the problems of centrifugal pump design and application places at the user's command a complete line of modern, high quality pumps and a vast store of knowledge concerning pump application problems.



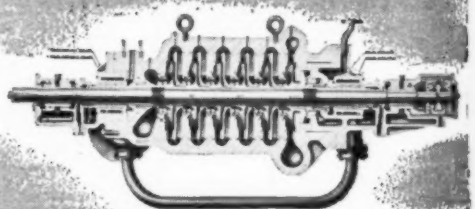
FOUR STAGE, OPPOSED IMPELLER PUMP



MIXED FLOW PUMP



CLOGLESS PUMP



HIGH PRESSURE, MULTI-STAGE PUMP

GP-1

TURBINES • HELICAL GEARS • WORM GEAR SPEED REDUCERS • CENTRIFUGAL PUMPS • CENTRIFUGAL BLOWERS AND COMPRESSORS • IMO OIL PUMPS

DE LAVAL

STEAM TURBINE COMPANY
TRENTON 2, NEW JERSEY

SALES OFFICES: ATLANTA • BOSTON • CHARLOTTE • CHICAGO • CLEVELAND • DENVER • DETROIT • DULUTH • EDMONTON • GREAT FALLS • HAVANA • HELENA • HOUSTON • KANSAS CITY • LOS ANGELES • MONTREAL
NEW ORLEANS • NEW YORK • PHILADELPHIA • PITTSBURGH • ROCHESTER • ST. PAUL • SALT LAKE CITY • SAN FRANCISCO • SEATTLE • TORONTO • TULSA • VANCOUVER • WASHINGTON, D.C. • WINNIPEG

COLUMBIA ESSENTIAL INDUSTRIAL CHEMICALS

SODA ASH

CAUSTIC ASH

CAUSTIC SODA

*PHOSFLAKE
(Bottle Washer)

MODIFIED SODAS

LIQUID CHLORINE

CALCIUM CHLORIDE

*PITTCHLOR
(Calcium Hypochlorite)

*SILENE EF
(Hydrated Calcium Silicate)

SODIUM BICARBONATE

*SODA BRIQUETTES
(Iron Desulphurizer)

*CALCENE T
(Precipitated Calcium Carbonate)

*Trade Marks Registered
U. S. Patent Office

COLUMBIA CHEMICALS

PITTSBURGH PLATE GLASS COMPANY
COLUMBIA CHEMICAL DIVISION

FIFTH AVENUE at BELLEFIELD • PITTSBURGH 13, PA.

CHICAGO • BOSTON • ST. LOUIS • PITTSBURGH • NEW YORK • CINCINNATI • CLEVELAND
PHILADELPHIA • MINNEAPOLIS • CHARLOTTE • SAN FRANCISCO

Saving money—Day

The indisputable fact that cast iron pipe, under normal conditions, offers a century or more of useful life, might lead to a false conclusion.

Namely, that taxpayers do not benefit from the economies of cast iron pipe until it has served for a century or more. Nothing could be farther from the truth.

The fact is that cast iron pipe saves money day by day as well as century by century. And here's why.

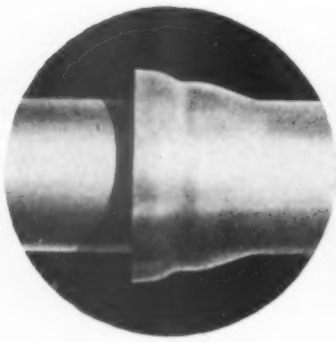
The *maintenance cost* of cast iron water distribution mains is far below that of other pipe materials—proved by reports from nearly 200 water works superintendents.

The cost of cast iron pipe *per service year* (investment cost plus maintenance) is far below that of other pipe materials—proved by the records of 200 of America's largest cities.

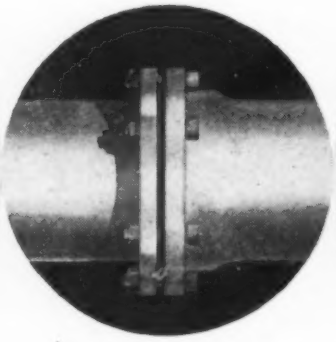
Yes, today's taxpayers get the benefit of these economies, through lower cost of maintenance, fewer street openings for repairs, and avoided replacements, otherwise necessary, if shorter-lived pipe were used.

The *known* useful life of cast iron pipe is at least double the *estimated* life of other pipe materials used for water distribution mains. Cast Iron Pipe Research Association, T. F. Wolfe, Research Engineer, Peoples Gas Bldg., Chicago 3.

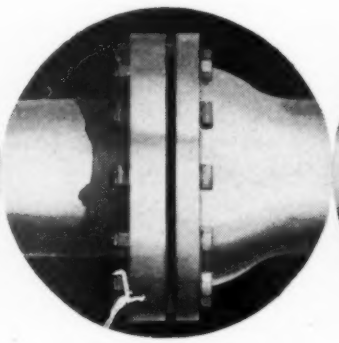
Because of its all-purpose adaptability for service under ground or under water, cast iron pipe is available with joints for every requirement, as shown below.



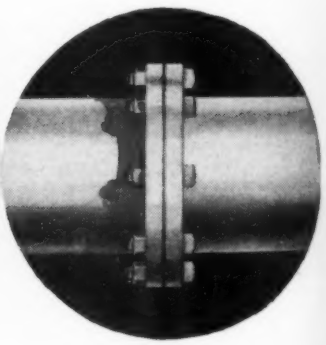
Bell-and-Spigot Joint—the time-tried and standard for water and sewerage service.



Mechanical Joint—now standardized with interchangeable parts.



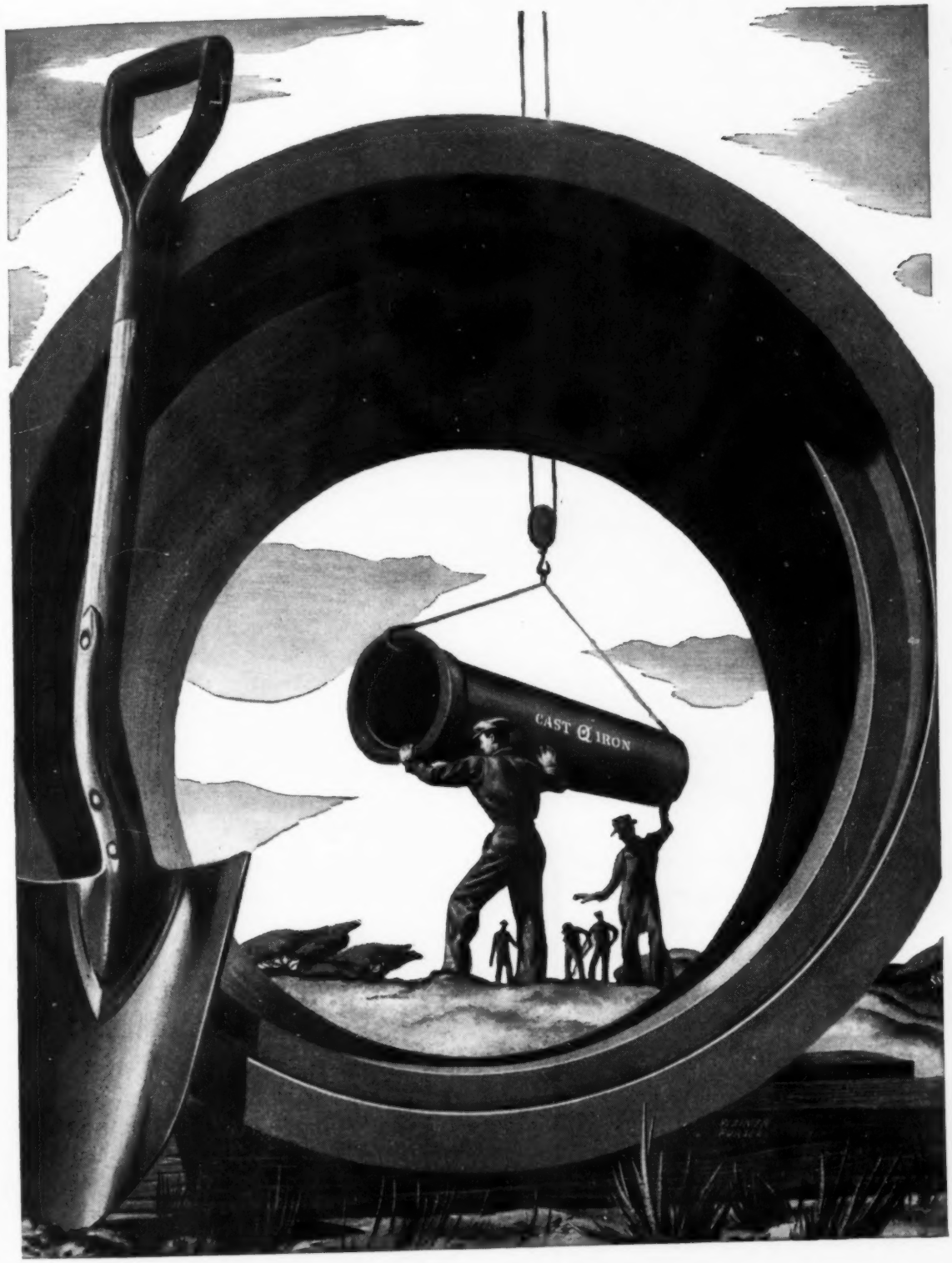
Flexible Joint—for river crossings and other sub-aqueous installations.



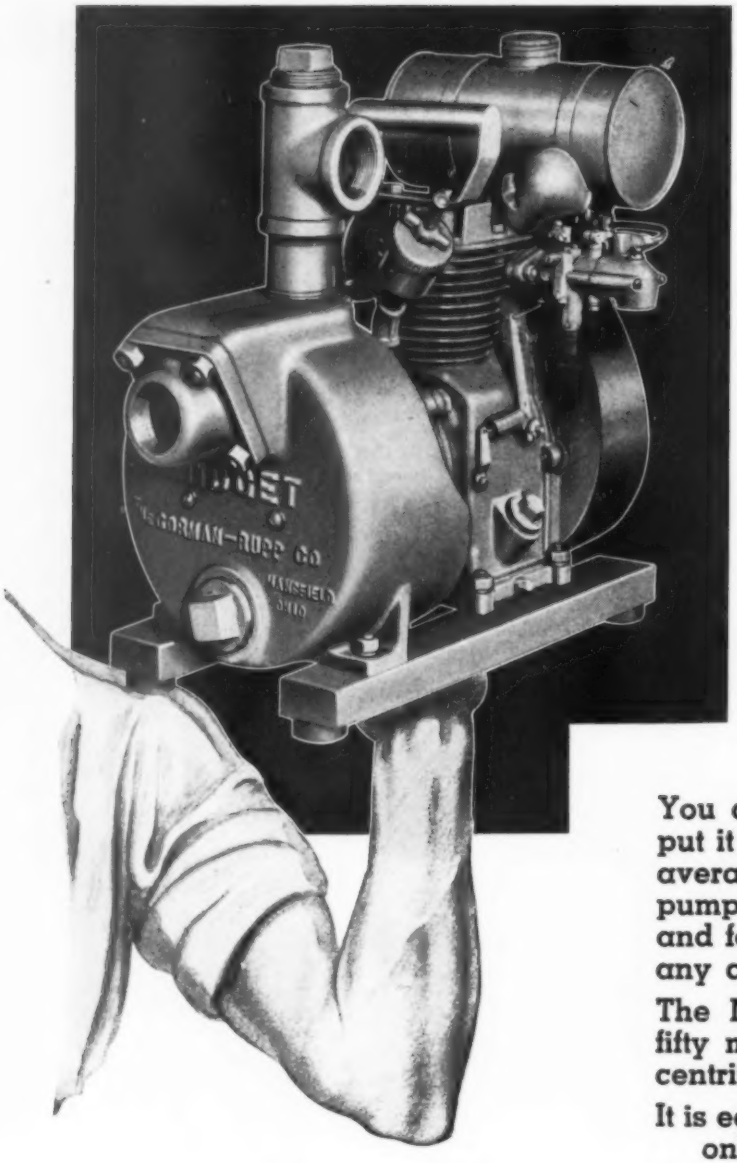
Flanged Joint—for water steam, oil or gas lines, generally used above ground.

CAST IRON PIPE

by Day—Century by Century!



Serves for Centuries



A MIDGET *in size* *A* GIANT *for work*

You can lift it with one hand -- you can put it on the toughest job you can find. At average heads the Gorman-Rupp "Midget" pump will handle 3000 gallons per hour and for longer time and less attention than any comparable pump.

The Midget is the smallest of more than fifty models of Gorman-Rupp, self-priming, centrifugal pumps.

It is easily carried from job to job -- weighs only 60 pounds.

It is automatic self-priming -- when the engine starts the water starts.

It is non-clogging -- will handle any muck or solids that will pass the intake strainer.

It is economical -- pumps more per pound of pump than any other pump on the market.

Other models will handle capacities up to 125,000 gallons per hour. There is a size of Gorman-Rupp self-priming centrifugal pump to meet any pumping requirement. Our nearest distributors will send you one and let you be the judge. If it doesn't do a better job than any pump you have seen, return it at our expense.

Write for further information.

For Details call your nearest distributor.

FOUR of more than 50 models of Gorman-Rupp Pumps

Capacity in Gals. Per Hour with pump 15 ft. above water

Total Head	Midget (60 lbs.)	Eagle (120 lbs.)	40-M (1080 lbs.)	90-M (1600 lbs.)
25	3960	11220		
30	3840	10200	34500	76800
40	3720	8400	33900	73800
50	3300	6900	32700	69600
60	2280	5100	30600	63000

THE GORMAN-RUPP COMPANY

GORMAN-RUPP PUMPS — UNSURPASSED FOR PUMPING FAST

327 Bowman Street **Mansfield, Ohio**

ADVANTAGES OF PRESTRESSED CONCRETE CYLINDER PIPE • NO. 2

..... In all Sizes

● The Lock Joint Pipe Company is now prepared to supply Prestressed Concrete Cylinder Pipe in sizes from 16" to 84" diameter—and even larger—for high pressure pipelines.

Prestressed Concrete Cylinder Pipe retains the fundamental principles of Lock Joint design in having a continuous welded steel cylinder with steel joint rings forming bell and spigot ends with a rubber gasket as a sealing element. The cylinder is lined with a substantial thickness of concrete and after proper curing is spirally wound with high tensile wire under tension.

This method of design makes available pipe in all sizes for higher range of heads with the same economy of first cost and maintenance which Lock Joint Pressure Pipe has always effected. That's one of the reasons you'll find Prestressed Concrete Cylinder Pipe an ideal product for your water supply and distribution mains and oil or gas transmission mains.

A Hazen-Williams Hydraulic Slide Rule will gladly be sent upon request with our compliments.

LOCK JOINT *Reinforced Concrete* PRESSURE PIPE

LOCK JOINT PIPE COMPANY

Established 1905

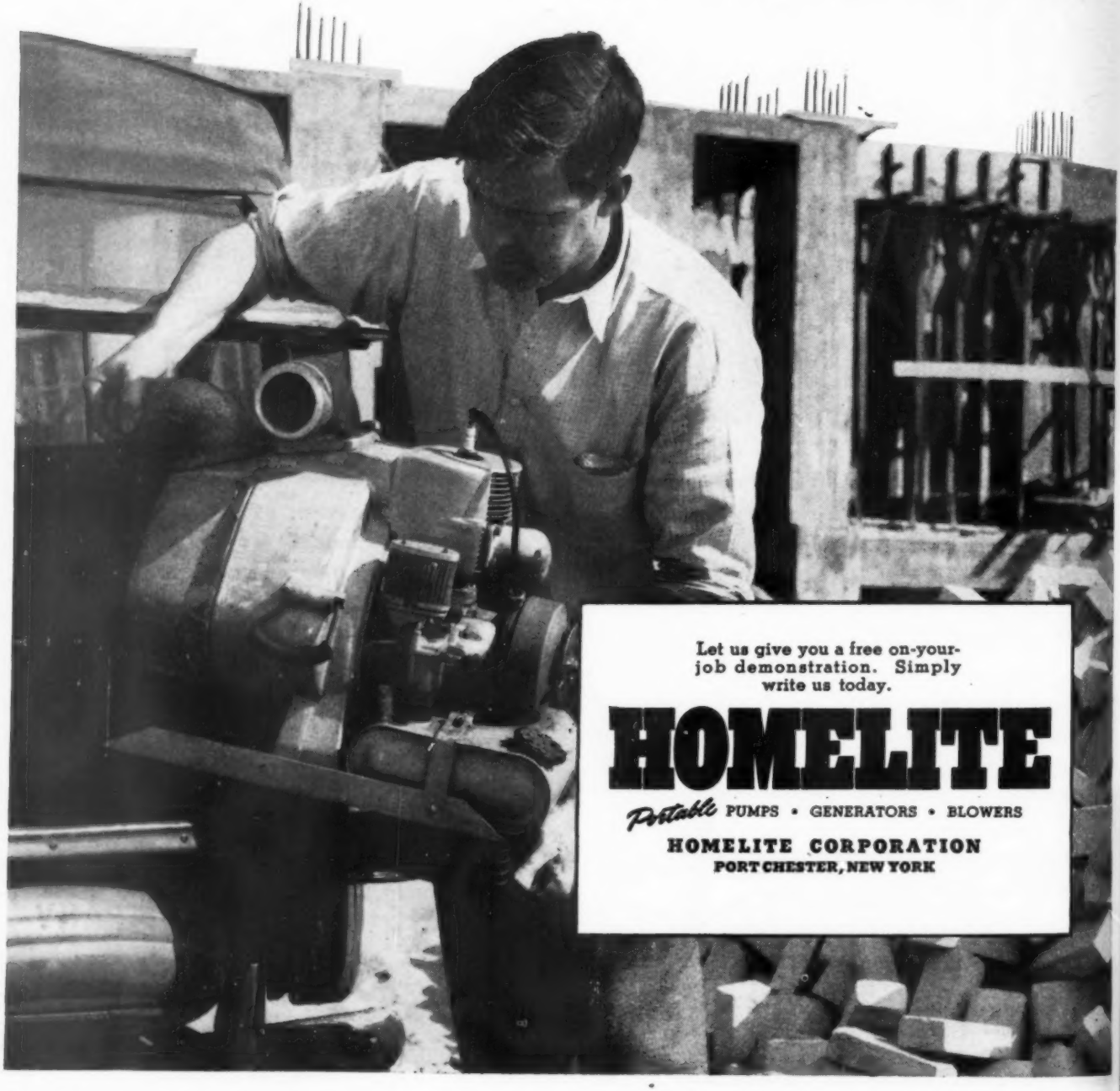
P. O. BOX 269, EAST ORANGE, NEW JERSEY

Denver, Colo. · Chicago, Ill. · Kenilworth, N. J. · Kansas City, Mo. · Rock Island, Ill. Joplin, Mo. · Valley Park, Mo. · Cleveland, Ohio · Hartford, Conn. · Navarre, Ohio

SCOPE OF SERVICES *Lock Joint Pipe Company specializes in the manufacture and installation of Reinforced Concrete Pressure Pipe for Water Supply and Distribution Mains of large diameter as well as Concrete Pipe of all types for Sanitary Sewers, Storm Drains, Culverts and Subaqueous lines.*

The Pump THAT WASTES NO TIME

Easily portable, self-priming, fast-pumping and completely automatic, a Homelite Gasoline-Engine-Driven Pump gets to a job and does its job with no waste of time or manpower.



Let us give you a free on-your-job demonstration. Simply write us today.

HOMELITE

Portable PUMPS • GENERATORS • BLOWERS

HOMELITE CORPORATION
PORT CHESTER, NEW YORK

A sewer pipe affect the size of a treatment plant? Yes—when you consider these facts:

Conservative estimates show that more than 25% of the contents of the average sewer line is infiltrated ground water. This means an unnecessarily heavy load on the treatment plant—a larger volume of sewage to be treated.

Transite Sewer Pipe, however, provides the advantage of exceptionally tight joints. These joints stay tight in service—effectively safeguard against costly infiltration. Designers, taking the reduced load into account, can frequently figure on smaller treatment plants, effect substantial economies in buildings and equipment. Equally important, treatment costs are lowered. And plant capacity is conserved for future needs.

But that's not the whole Transite story. Installation of Transite Sewer Pipe is faster and more economical because Transite's long, 13-foot lengths and light weight reduce handling costs. Fewer joints are needed, less time and effort are required for accurate laying to line and grade. Because Transite has an exceptionally high carrying capacity (n=.010), flatter grades—or smaller diameter pipe—may often be used. And Transite's asbestos-cement structure means high corrosion-resistance through the years.

For details on Transite Sewer Pipe, write Johns-Manville, Box 290, New York 16, N. Y.

JOHNS-MANVILLE JM PRODUCTS

Johns-Manville TRANSITE SEWER PIPE

Public enemy . . . on the way out!

ONE BY ONE, the enemies to public health are being defeated. City ordinances condemn the obvious. City projects—backed by civic-minded officials—oust those evils that manage to stay within the law.

High on the list of enemies to public health is garbage. Garbage in the pail on the back doorstep. Garbage in heaps on the city dump.

And now—thanks to the vision and foresight of sanitation experts—these eyesores and breeders of disease are on the way out. A new and revolutionary method of garbage disposal, recognized and endorsed by sanitation authorities in hundreds of cities, combines and eliminates food and human wastes through one common channel—the existing sewer system and sewage treatment plant.

The device which makes this method practical as well as possible is the General Electric Disposall*—a conveniently installed kitchen appliance which shreds food wastes into fine particles and flushes them into the sewer system. *And the Disposall does not interfere with present sewage works practice!*

In operation in many cities today, the Disposall is proving itself an efficient friend of the housewife and a valuable asset to a clean, healthful community.

QUESTIONS AND ANSWERS ABOUT THE DISPOSALL METHOD OF REMOVING GARBAGE

1. Will Disposalls cause sewer system stoppages?

Absolutely not! The Disposall shreds food wastes into such fine particles that they flow freely through pipe lines, without shoaling or settling.

These wastes are actually finer, more water-buoyant and uniform than human wastes and other solids now flowing through your lines. They are ground in a controlled amount of cold water which congeals and "homogenizes" greases into a form which will not clog sewer lines.

2. Has the Disposall been thoroughly tested?

Yes! More than ten years of testing in research laboratories and a decade of practical use in several hundred communities have proved the Disposall to be an effective sanitation device.

3. Why is it necessary to eliminate garbage?

Garbage is a public enemy—a menace to community health. There is only one way to combat it. And that is to eliminate it *immediately*—before it has a chance to attract flies, rats, and other carriers of disease. The garbage can is a Pandora's box of germs—as dangerous to public health as the outhouse of yesterday.

Disposall sounds the death knell for the garbage can as surely as modern sewer systems solved the unsanitary conditions of another era. Food waste is as dangerous as human waste. Both are odorous, decaying matter. Both should be dissipated—removed—on the spot. And the modern sewer system offers unseen transportation for both wastes.

4. Will the volume of sewage flow be increased?

Even if every home used a Disposall, the volume of sewage flow would be increased less than two per cent. Not for many years will the number of Disposalls in your community become large enough to add appreciably to the loading on the treatment plant.

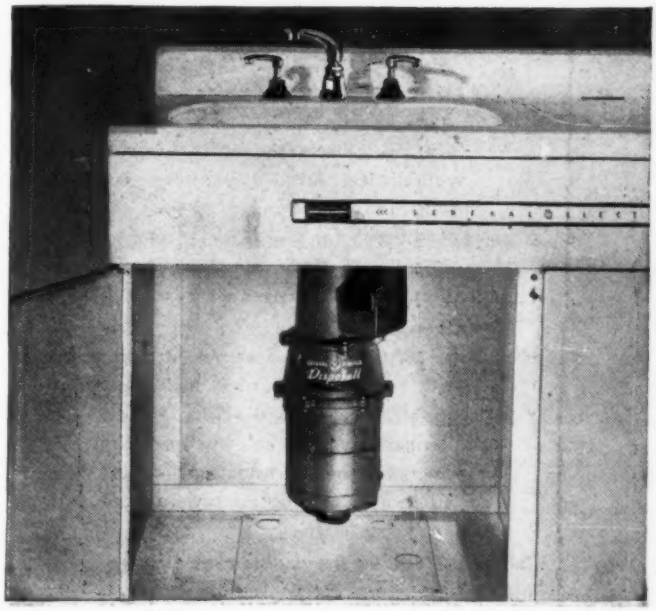
Although the addition of food wastes to the sewage flow will increase the solids and organic loading on the plant, many plants will be able to handle this gradual increase in loading for some time to come. Others can be expanded when necessary.

5. Do communities need sewage treatment plants?

Sewage treatment plants are a vital safeguard for public health—whether or not Disposalls are used. An important contribution that Disposalls make to the welfare of the community is that they provide further incentive for the building of these much-needed plants.

6. Are there any other questions you would like to have answered?

Further information about the Disposall is available, and will be furnished you upon request. We shall be happy to answer any specific questions you may care to ask. Simply write to Department WSW1246, Appliance and Merchandise Department, General Electric Company, Bridgeport 2, Conn.



The General Electric Disposall shown installed in the General Electric Sink. Food wastes are scraped into drain opening and safety cover placed in position. Cold water is then turned on, starting the Disposall operation. Food waste is shredded and flushed away automatically.

Disposall
*TRADE-MARK REG. U. S. PAT. OFF.
CONVERTS FOOD WASTE TO SEWAGE—ELIMINATES "GARBAGE"
GENERAL ELECTRIC

How much does it cost to make a Pump?

It costs a lot of money to make any pump—especially if you want to be a leader, not a follower, and to build a pump so efficient, so dependable that it will be second to none.

You pay the expense of maintaining well-staffed laboratories for product investigation and research—for continuous search for high efficiencies, better applications—and for the thorough testing of your finished product.

You pay the expense of providing production facilities and techniques; you pay for new materials, new methods which, with the cost-reducing benefits of mass production, assure your customers of greatest satisfaction.

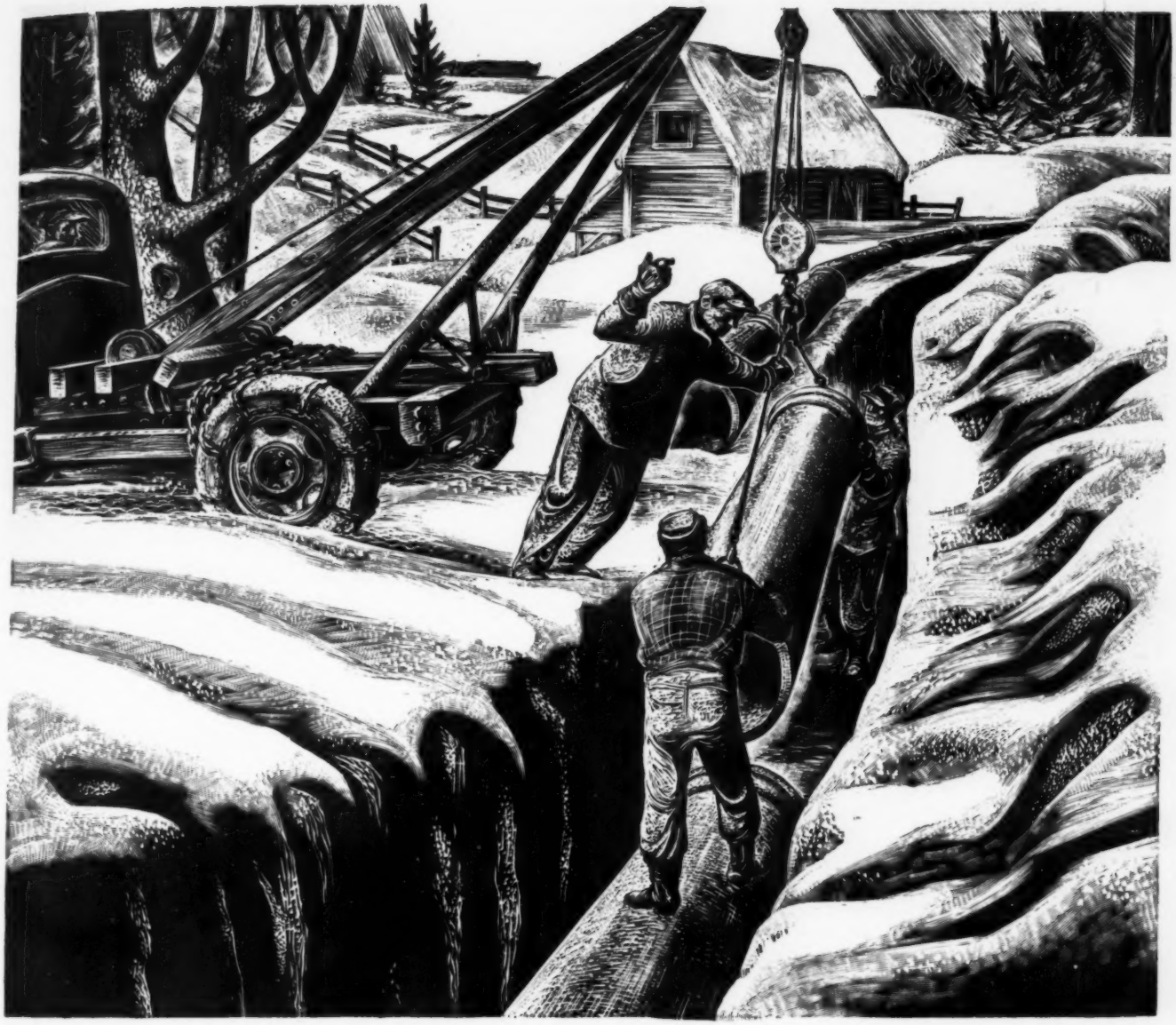
Finally, you've the problem of making it easy for your customers to reach you for sales, service and consultation; you must network the country with distribution centers manned by experts.

Yes, all this costs a lot of money. No wonder, then, that there are so few pump manufacturers with this valued background. Among them, Fairbanks-Morse is an unquestioned leader in all phases of liquid-moving service . . . For all pumping problems, first see your Fairbanks-Morse dealer or call at the nearest Fairbanks-Morse branch office.

FAIRBANKS-MORSE

A name worth remembering

DIESEL LOCOMOTIVES · DIESEL ENGINES · MAGNETOS · GENERATORS · MOTORS · PUMPS
SCALES · STOKERS · RAILROAD MOTOR CARS and STANDPIPES · FARM EQUIPMENT



Original Woodcut by Lynd Ward

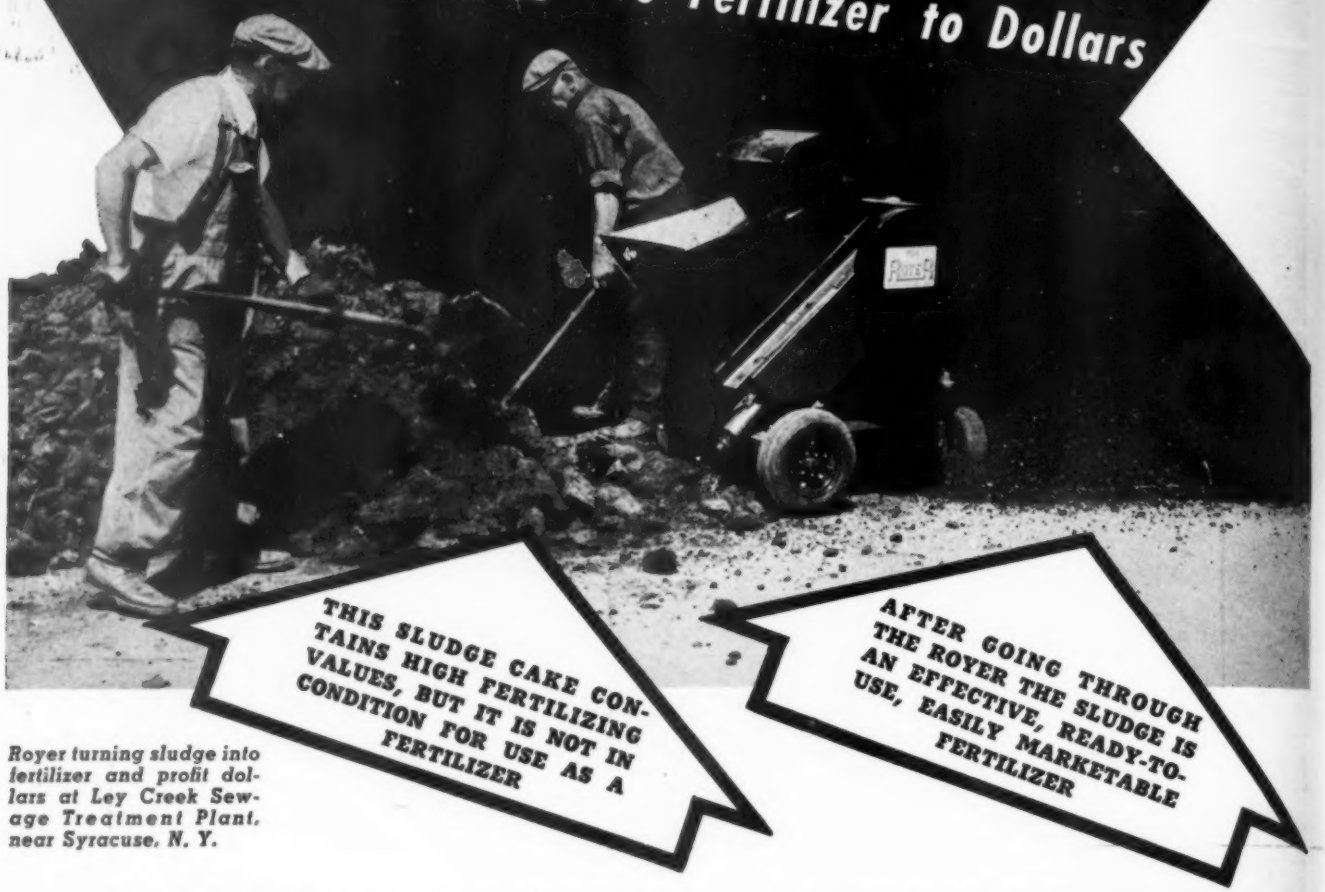
It is probably cold comfort to a construction crew, on a winter morning, to realize that the cast iron supply line they are installing will bring needed protection to the safety and health of a community.

Long range planning for adequate water supply logically includes long-lived cast iron mains. Their reliability and low annual cost are proved by century-old pipe, still in service, even though made without benefit of the improved methods by which U. S. Cast Iron Pipe is produced in our modern plants.

U.S. cast iron PIPE

U. S. PIPE & FOUNDRY CO.
General Offices: Burlington, N. J.
Plants and Sales Offices throughout the U. S. A.

Transforming Sludge to Fertilizer to Dollars


THIS SLUDGE CAKE CONTAINS HIGH FERTILIZING VALUES, BUT IT IS NOT IN CONDITION FOR USE AS A FERTILIZER
AFTER GOING THROUGH THE ROYER THE SLUDGE IS AN EFFECTIVE, READY-TO-USE, EASILY MARKETABLE FERTILIZER

Royer turning sludge into fertilizer and profit dollars at Ley Creek Sewage Treatment Plant, near Syracuse, N. Y.

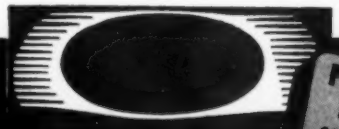
Simplicity itself is the process of converting sewage sludge into fertilizer and in turn into profit dollars with the Royer Sludge Disintegrator. The labor is actually less than that required for the wasteful practices of incinerating or burying the sludge, as all the operator has to do is shovel the sludge cake into the hopper.

The Royer also converts the cost of sludge disposal into a steady dollar return. The value of sludge fertilizer has become universally recognized during recent years. Sewage treatment plants with Royers report an active demand for their fertilizer among growers of food crops, florists and nurseries. Any seasonal surplus is used in the city parks. Fertilizer produced with Royers is sold under various trade names by sewage plants in all parts of the nation.

The Royer is a sturdy, inexpensive machine with assured trouble-free operation. It readily handles sludge cake with a moisture content up to 51%. In one operation the sludge is thoroughly shredded, mixed, aerated and further dried. Trash is automatically eliminated. The Royer discharges onto piles or into trucks an effective, ready-to-use fertilizer; reduced to a size that most readily yields its nutritive elements to plant growth. Enriching chemicals may be added during the shredding operation to make a high strength fertilizer.

Twelve models—electric motor, gasoline engine or belt-to-tractor driven.

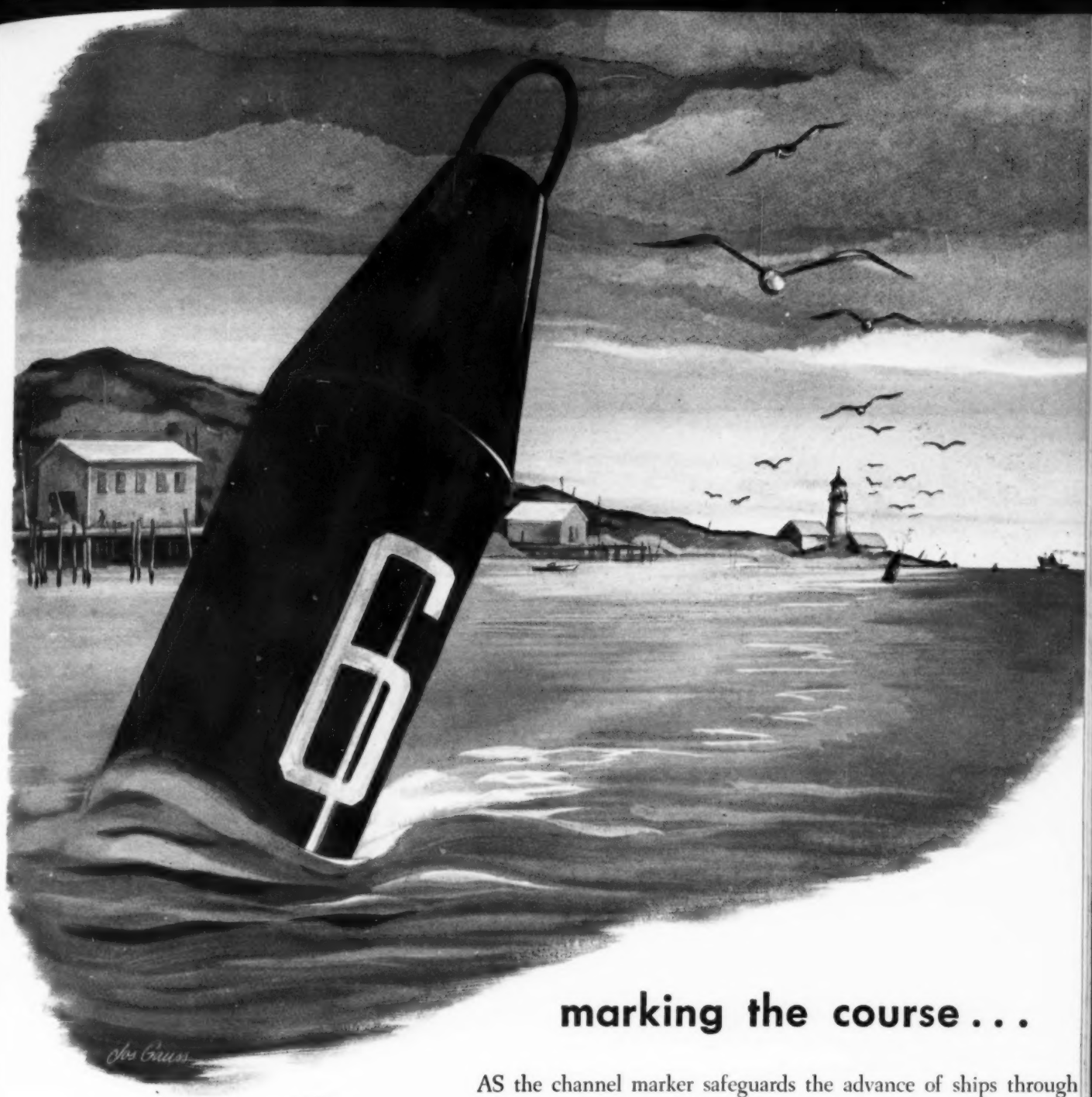
Write for our "Sewage Sludge Utilization Datalog." It shows how you can profit from the production of sludge fertilizer.



ROYER FOUNDRY & MACHINE CO.

170 PRINGLE ST., KINGSTON, PA.

PIONEERS IN THE SALVAGE OF SEWAGE SLUDGE



marking the course . . .

AS the channel marker safeguards the advance of ships through harbors and rivers, so do the findings of the pioneer research chemists provide "sure passage" for advancing industry.

Pioneering in electro-chemical product development, Niagara has helped to chart many new courses by which various industries are going forward. In addition to producing Caustic Potash, Carbonate of Potash and Liquid Chlorine for the first time in America, Niagara has consistently led in adapting these materials to new uses.

The specialized "know-how" and experience Niagara has gained in this work are the basis of the alert and progressive product service which Niagara offers to its customers throughout industry.

Niagara Alkali Company, 60 East 42nd Street, New York 17, N. Y.

THE PIONEER CREED

Always New, Always Better

Since the turn of the century Niagara has pioneered basic electro-chemical development in this country. This experience is reflected not only in Niagara product quality but also in the efficiency of the service Niagara extends to customers seeking to mark new trails to product improvement.

AN ESSENTIAL PART OF AMERICA'S GREAT CHEMICAL ENTERPRISE

Niagara Alkali Company

CAUSTIC POTASH • CAUSTIC SODA
CARBONATE OF POTASH

LIQUID CHLORINE • NIAGATHAL
PARADICHLOROBENZENE

FOR CERTAINTY IN CHEMICAL CONTROL

. . . *Rely on* B&A *Reagents*

Nowhere is chemical control more vital than in today's water and sewage plants. Upon the purity of drinking waters . . . upon the proper treatment of wastes . . . public health depends. The plant chemist working with the precision tools of his profession is the guardian of the community he serves; every test and every analysis he makes must be done with unerring accuracy.

For certainty in such responsible work, depend on B&A Reagents.

These high purity products of General Chemical Company's Baker & Adamson Division are chemical micrometers for your most exacting analyses. They are made to the decimal-point accuracy of A.C.S. standards . . . and are backed by all the specialized skills and science B&A has developed in 64 years of "setting the pace in chemical purity." **Extensive stocks** of B&A Reagents are carried at the Company's *own* chain of regional warehouses from coast to coast.* Use the one nearest you to fill your reagent needs. By telling the B&A Technical Serviceman your month-to-month requirements he can plan with you in building these local stocks to supply you quickly . . . conveniently . . . whenever you call.

Do you have this 200-page catalog?

If you buy or specify industrial laboratory reagents, you will find the 200-page book of B&A products an invaluable guide to 1,000 quality chemicals. *For free copy,* make request on business letterhead to nearest B&A office below.

REAGENTS
BAKER & ADAMSON
B&A
QUALITY
STANDARD OF PURITY
FINE CHEMICALS

GENERAL CHEMICAL COMPANY

BAKER & ADAMSON DIVISION

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Sales and Technical Service Offices: Albany* • Atlanta • Baltimore • Birmingham* • Boston • Bridgeport Buffalo* • Charlotte* • Chicago* • Cleveland* • Denver • Detroit* • Houston • Kansas City Los Angeles* • Minneapolis • New York* • Philadelphia* • Pittsburgh* • Providence • St. Louis* San Francisco* • Seattle • Wenatchee (Wash.) • Yakima (Wash.)
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SETTING THE PACE IN CHEMICAL PURITY SINCE 1882

* Complete stocks carried here.

It's a cinch

THERE'S A FLEXIBLE TOOL FOR EVERY PIPE CLEANING JOB

UNWINDING FLEXIBLE ROD FROM ROD REEL

With Flexibles you can get right to work on any pipecleaning job — no delays. Flexible Rods are always in order when wound on the rod reel. With rod reel mounted on your truck the rod is ready for instant use. Saves time — easier to handle.

PLACING THE ROD GUIDE IN THE MAN-HOLE

Fewer dig-ups are necessary when Flexible Sewer Rods are used. Flexibles work efficiently through man-holes reducing by 50% the number of dig-ups usually required. Flexible methods eliminate the hard unsanitary part of the job.

ONE OF THE MANY TOOL ATTACHMENTS FOR ROD

The cork screw illustrated here, whether turned by hand or powered by Flexible Power Drive, cuts roots from pipes quickly and easily. In fact, a few men can clean more than 2,000 feet of pipe per day with Flexible Equipment—more than an entire crew can do by using old outmoded methods.

...THAT'S ALL IT TAKES TO DO THE JOB

Flexible Standard City Sets bore through pipe stoppages quickly. It's seldom necessary to tear up city streets to clean pipes when you use Flexibles. Write for illustrated Flexible catalog.

MOTOR POWER DOES THE WORK . . . CUTS THROUGH OBSTRUCTIONS

Sturdy Flexible "Power Drive" simplifies pipe cleaning jobs by rotating the Flexible Rod so it bores right through heavy deposits of sand, roots and obstructions at 5 times the speed possible by hand turning.

855 Board of Trade Bldg., Chicago 4, Ill.
228 W. Broad St., Columbus 8, Ohio
1624 Marmon Place Minneapolis 3, Minn.
P.O. Box 165 Atlanta
P.O. Box 447 Lancaster, Texas
41 Greenway St. Hamden, Conn.
147 Hillside Ter., Irvington, N. J.
P.O. Box 694 Pittsburgh
401 Broadway, New York 13
29 Cordan Ave., Roslindale 31, Mass.

Flexible SEWER ROD EQUIPMENT CO.

9059 VENICE BOULEVARD • LOS ANGELES • CALIF.

CLAY PIPE PROVIDES *Safety factor* IN INDUSTRIAL EXPANSION

Far-Sighted Planners of new industrial plants *play safe* when they specify Clay Pipe, because they can depend on it to safely carry any industrial waste . . . no matter to what new products or processes the plant may change over at some future date. The use of Clay Pipe is *insurance* against expensive plant shut-downs likely to be caused if corroded or decomposed sewer and drain lines must be dug up and replaced.

Clay Pipe's hard, tough texture resists the attacks of acids, chemicals and all types of industrial wastes. This dependable material is so completely inert to corrosion that it was a necessity in building fume-carrying ducts and waste disposal lines at the Oak Ridge atomic bomb factories! You're taking no chances when you specify "Clay."

For information about Clay Pipe, write to:

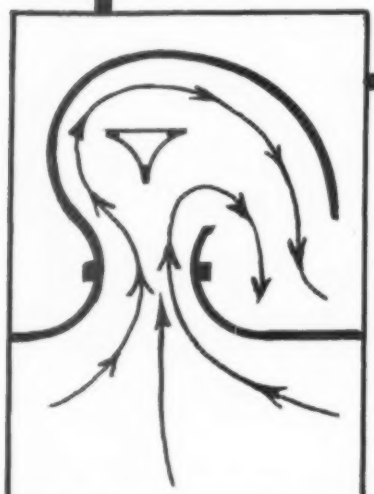
NATIONAL CLAY PIPE MANUFACTURERS, INC.
111 W. Washington St., Chicago 2, Ill.
522 First National Bank Bldg., Atlanta 3, Ga.
1105 Huntington Bank Bldg., Columbus 15, Ohio
571 Chamber of Commerce Bldg., Los Angeles 15, Calif.

CLAY PIPE CLAY PIPE NEVER WEARS OUT! C-1146-10

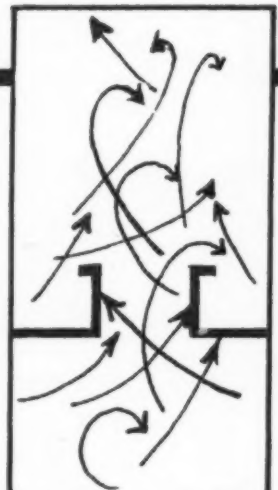
MYTH #1 EXPLODED!

A PERFECTLY DESIGNED TANK VENT VALVE IN FULL OPEN POSITION WILL FLOW MORE THAN AN OPEN NIPPLE.

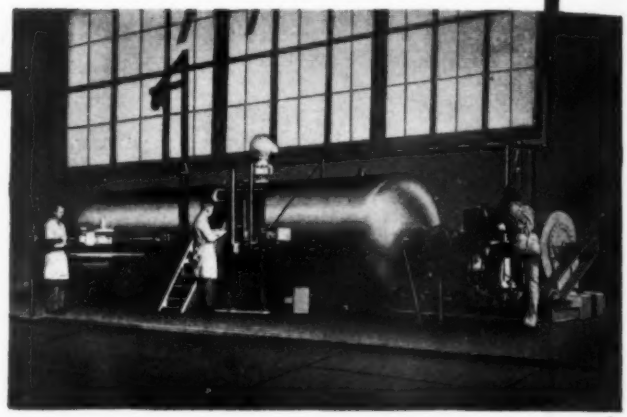
First in a series.



Good design channels the flow to smooth streamlined exit.



Excess turbulence friction and back pressure are present due to angularity of design.



"Varec" Testing Laboratory includes what we believe to be one of the largest and most up-to-date capacity finding apparatus in existence. It accurately determines pressure loss and flow capacities up to 500,000 cu. ft. of air per hour. It is here where great engineering studies have been made.

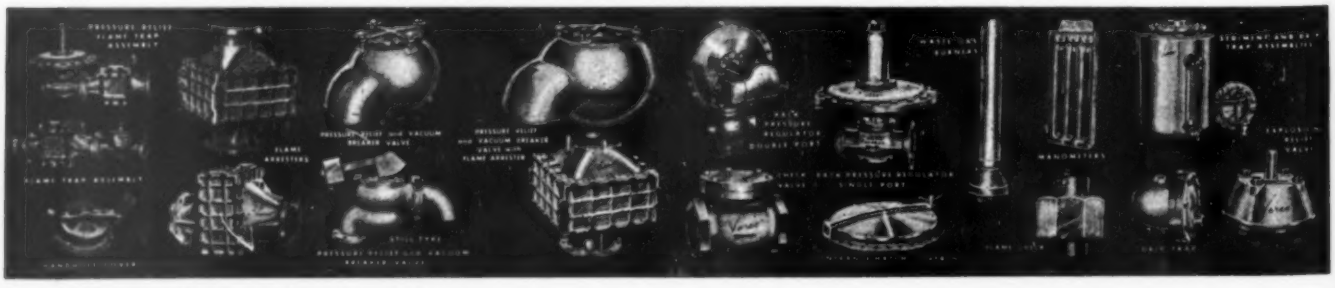
TROUBLE WITH TURBULENCE? Theoretical argument or calculation to the contrary, a perfectly designed tank vent valve, when installed on an open nipple, will ease the exit conditions of flow of the nipple so as to increase its actual flow capacity. Scientific flow tests have proved that the combination of such a valve and nipple will flow *more than the open nipple alone.* By installing a venturi type nozzle instead of a nipple, entrance conditions of flow to such a valve will be greatly eased. Under these conditions the flow capacity of the valve is further increased.

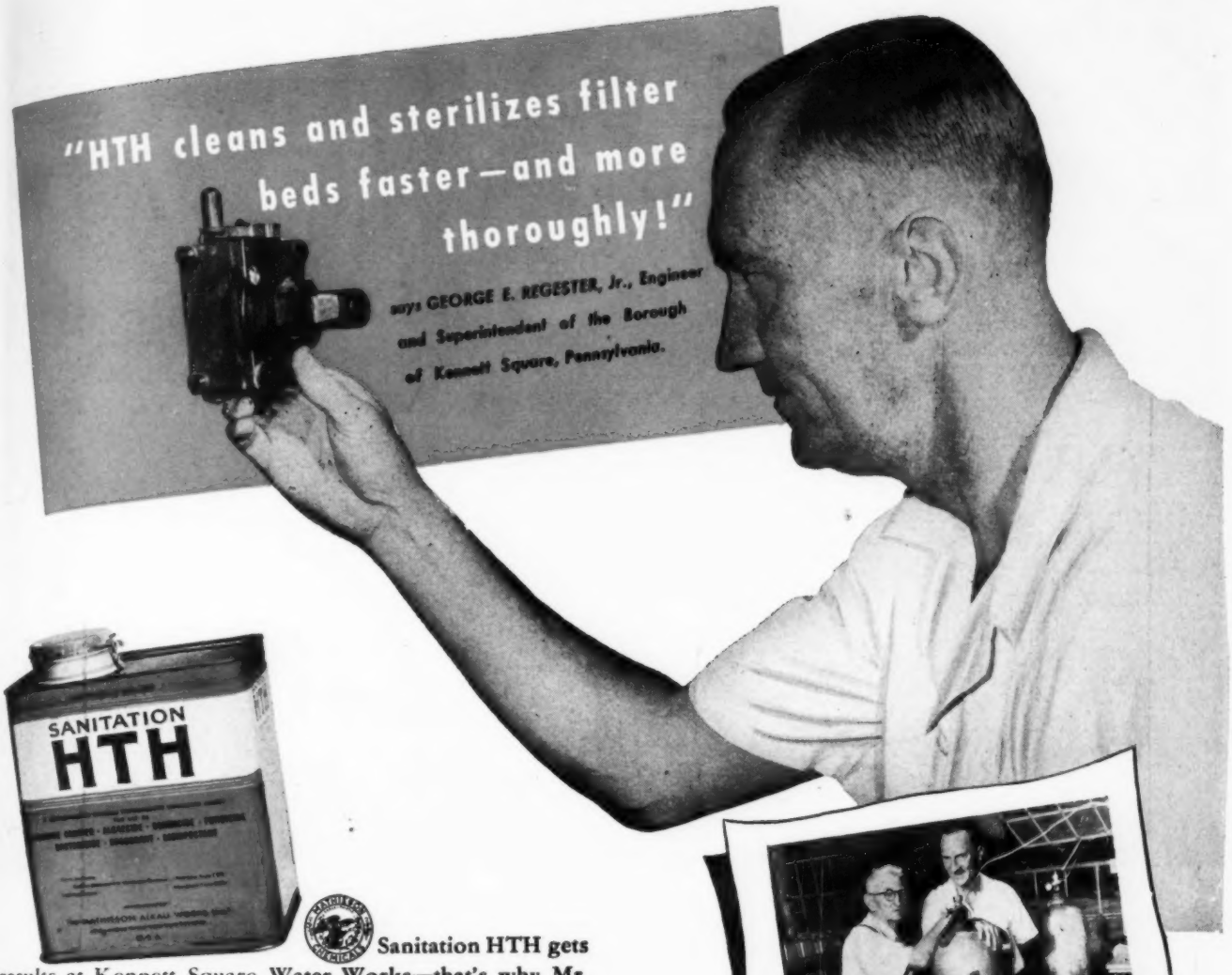
Additional engineering data and other pertinent information about vent valves, tank fittings, etc., will be found in Varec's new P-7 Catalog, a 200-page volume packed full of practical experience and sound technical knowledge.

It is the sincere belief of the Vapor Recovery Systems Company that "Varec" approved Streamlined Tank Vent Valves with expanding passageways and patented hyperbolic inner valves more nearly approach this degree of turbulent-free perfection than other possible designs. Illustrated here is the "Varec" approved Pressure Relief and Vacuum Breaker Valve with Flame Arrester. *Fig. No.* 58C.

THE VAPOR RECOVERY SYSTEMS COMPANY
COMPTON ——— CALIFORNIA ——— U. S. A.
NEW YORK CITY — CHICAGO, ILL. — CLEVELAND, OHIO — HOUSTON, TEXAS — TULSA, OKLA.
Agencies Everywhere. Cable Address VAREC COMPTON (all Codes).

Reprints of this ad for departmental discussion may be obtained from "Varec", Compton, Calif.




"HTH cleans and sterilizes filter beds faster—and more thoroughly!"
says GEORGE E. REGESTER, Jr., Engineer and Superintendent of the Borough of Kennett Square, Pennsylvania.

Sanitation HTH gets results at Kennett Square Water Works—that's why Mr. Regester always has it available for all-around sterilizing and for removing objectionable algae deposits. Mathieson liquid chlorine for chlorinating both raw and filtered water is another Kennett Square safeguard—"it's economical, too" says Mr. Regester. At this progressive water works, they also very wisely use Mathieson PH-Plus to maintain a constant pH.

Free to water works men is Mathieson's "Hypo-Chlorination of Water." This 80-page illustrated booklet discusses all standard sanitation practices; it also shows how Sanition HTH is used in emergencies . . . in treating filters . . . in controlling algae . . . in sterilizing new mains. Simply send in your request, and this highly-informative booklet will be mailed to you. *THE MATHIESON ALKALI WORKS (Inc.), 60 East 42nd Street, New York 17, N. Y.*

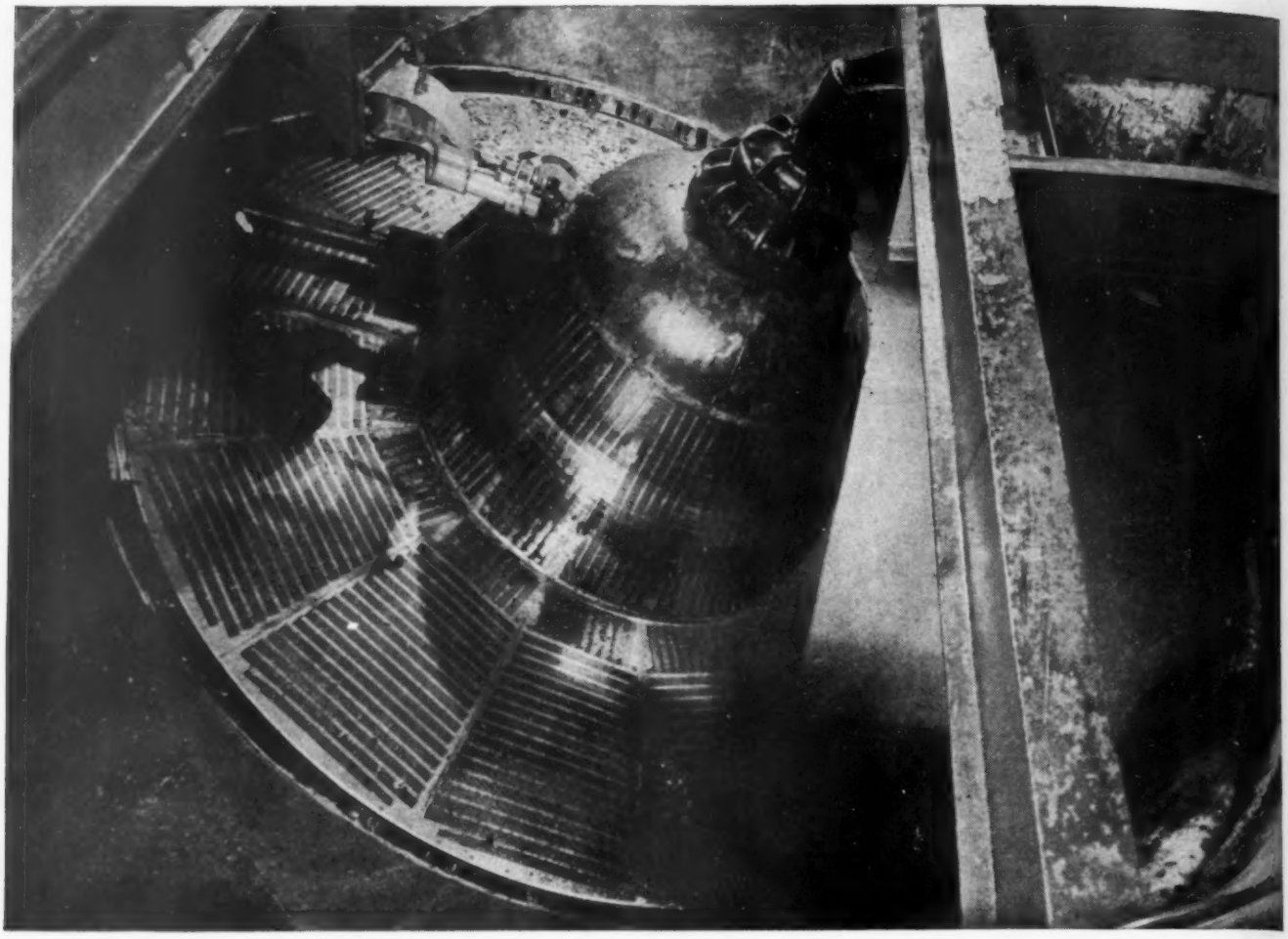
Left—William H. Vandever, veteran employee who has been using HTH for nearly 20 years.
Right—George E. Regester, Jr., Supt.

Kennett Square Water Works, Kennett Sq., Pa.

SANITATION HTH is available in cases of nine 5-lb. cans and in 100-lb. drums.

Mathieson
SANITATION HTH

Sanitation HTH . . . Liquid Chlorine . . . Chlorine Dioxide . . . PH-Plus (Fused Alkali) . . . Caustic Soda . . . Soda Ash . . . Bicarbonate of Soda . . . Ammonia, Anhydrous & Aqua . . . Dry Ice . . . Carbonic Gas . . . Synthetic Salt Cake . . . Sodium Chlorite Products . . . Sodium Methylate



New Jamaica Plant Specifies *Everdur* for Rugged Service

THIS 20-foot inclined revolving disc screen with cone and disc of slotted Everdur* plates, can handle 65 million gallons of sewage in 24 hours.

Two of these screens, designed and installed by Krajewski-Pesant Mfg. Corporation, are in service at the Jamaica Sewage Treatment Plant of the City of New York, removing solids and flocculent material to prepare sewage waters for subsequent activation.

In selecting time-tested Everdur for this rugged service, the manufacturers knew from long experience that these copper-silicon alloys possess exceptional resistance to the extremely corrosive conditions of sewage service . . . that they machine readily and may be formed, forged and welded.

It is this unusual combination of properties that dictates the use of Everdur where operating requirements are most severe. For detailed information, write for Publications E-11 and E-5. 46218

*REG. U. S. PAT. OFF.

Where Everdur Serves in NEW JAMAICA PLANT . . .

In four grit ejectors: Everdur for gate slides and cylinders, piston rods, valve stems, bolts and nuts.

In 5 hydraulic sluice gates: Bolts, facing strips, and other mounting parts. Also copper-silicon alloy 4¼-inch diameter operating stem.

In two inclined 20-foot diameter revolving disc screens: Slotted Everdur plates for cone and disc.

ANACONDA

Everdur

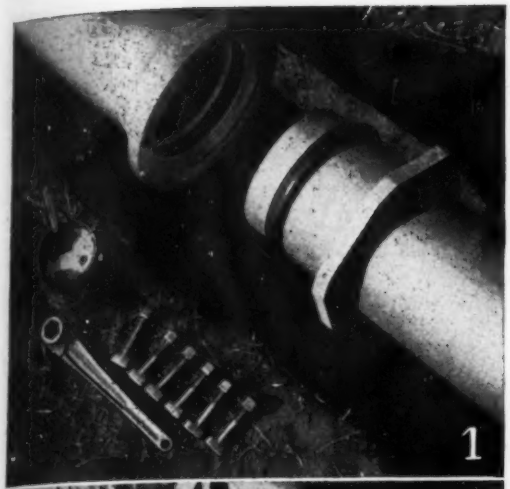
COPPER-SILICON ALLOYS

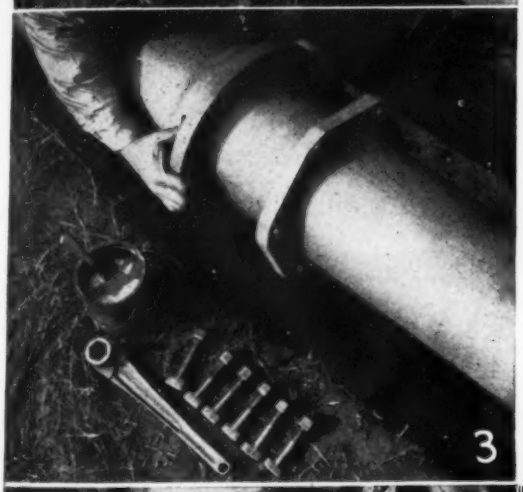
THE AMERICAN BRASS COMPANY

General Offices: Waterbury 88, Connecticut

Subsidiary of Anaconda Copper Mining Company

In Canada: ANACONDA AMERICAN BRASS LTD., *New Toronto, Ont.*





DOUBLEX SIMPLEX PIPE

for High Pressure Service

Doublex Simplex Pipe is the outgrowth of two major developments — pipe cast centrifugally in sand lined molds, and the development of a satisfactory joint embodying the stuffing box and gland principle. This pipe is ideal where flexibility, high strength and corrosion resistance are desired, and where a joint that is leak proof under high pressures is required.

This joint can be supplied for all sizes of Mono-Cast Centrifugal Pipe (3" through 48" diameter). The Doublex Simplex joint is easily and quickly made. The accompanying pictures illustrate the method of making it up. (1) Shows pipe in place with materials and tools necessary for making the joint — the rubber ring, the gland, bolts, a bucket of soapy water to serve as a lubricant, a brush and a wrench. (2) The length of pipe has been moved into place, and lubricant is being applied to the ring. (3) The ring is seated in socket. (4) Bolts are inserted and tightened by hand. (5) Final tightening is with the wrench. (6) The completed leak-proof joint.

Write for catalog of Mono-Cast Doublex Simplex Pipe and Fittings.

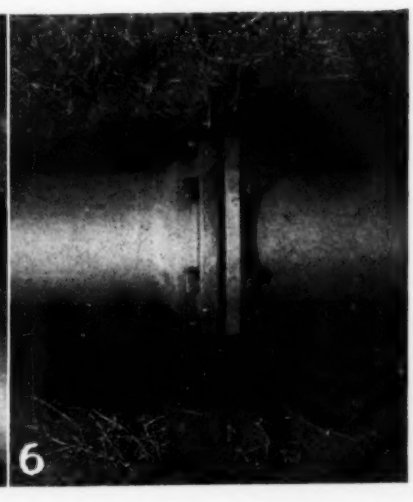
American

CAST IRON PIPE

Company

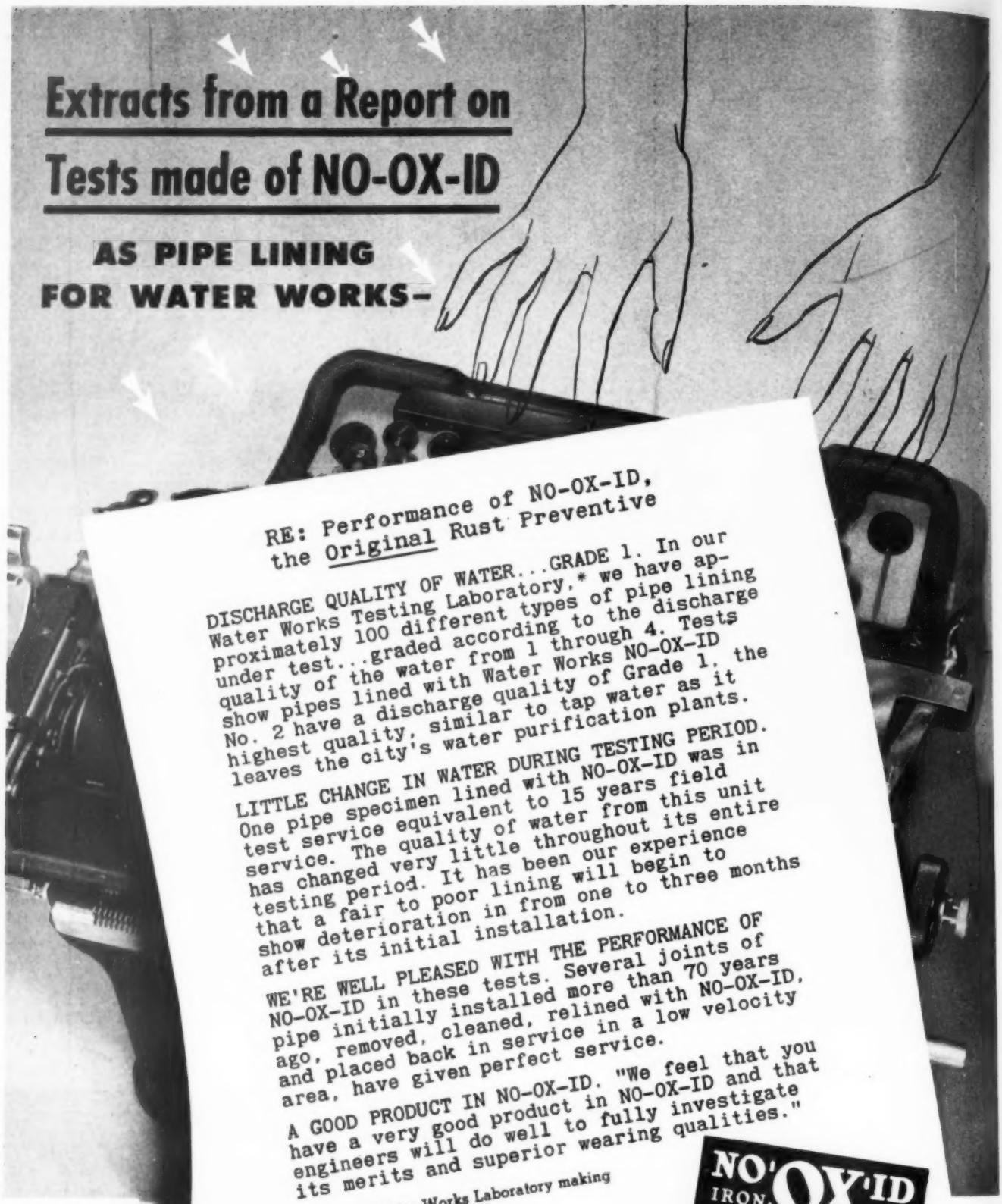
BIRMINGHAM 2, ALABAMA

Chicago Minneapolis Kansas City Los Angeles New York
Cleveland Dallas Houston San Francisco



Extracts from a Report on Tests made of NO-OX-ID

AS PIPE LINING FOR WATER WORKS—



RE: Performance of NO-OX-ID, the Original Rust Preventive

DISCHARGE QUALITY OF WATER...GRADE 1. In our Water Works Testing Laboratory,* we have approximately 100 different types of pipe lining under test...graded according to the discharge quality of the water from 1 through 4. Tests show pipes lined with Water Works NO-OX-ID No. 2 have a discharge quality of Grade 1, the highest quality, similar to tap water as it leaves the city's water purification plants.

LITTLE CHANGE IN WATER DURING TESTING PERIOD. One pipe specimen lined with NO-OX-ID was in test service equivalent to 15 years field service. The quality of water from this unit has changed very little throughout its entire testing period. It has been our experience that a fair to poor lining will begin to show deterioration in from one to three months after its initial installation.

WE'RE WELL PLEASED WITH THE PERFORMANCE OF NO-OX-ID in these tests. Several joints of pipe initially installed more than 70 years ago, removed, cleaned, relined with NO-OX-ID, and placed back in service in a low velocity area, have given perfect service.

A GOOD PRODUCT IN NO-OX-ID. "We feel that you have a very good product in NO-OX-ID and that engineers will do well to fully investigate its merits and superior wearing qualities."

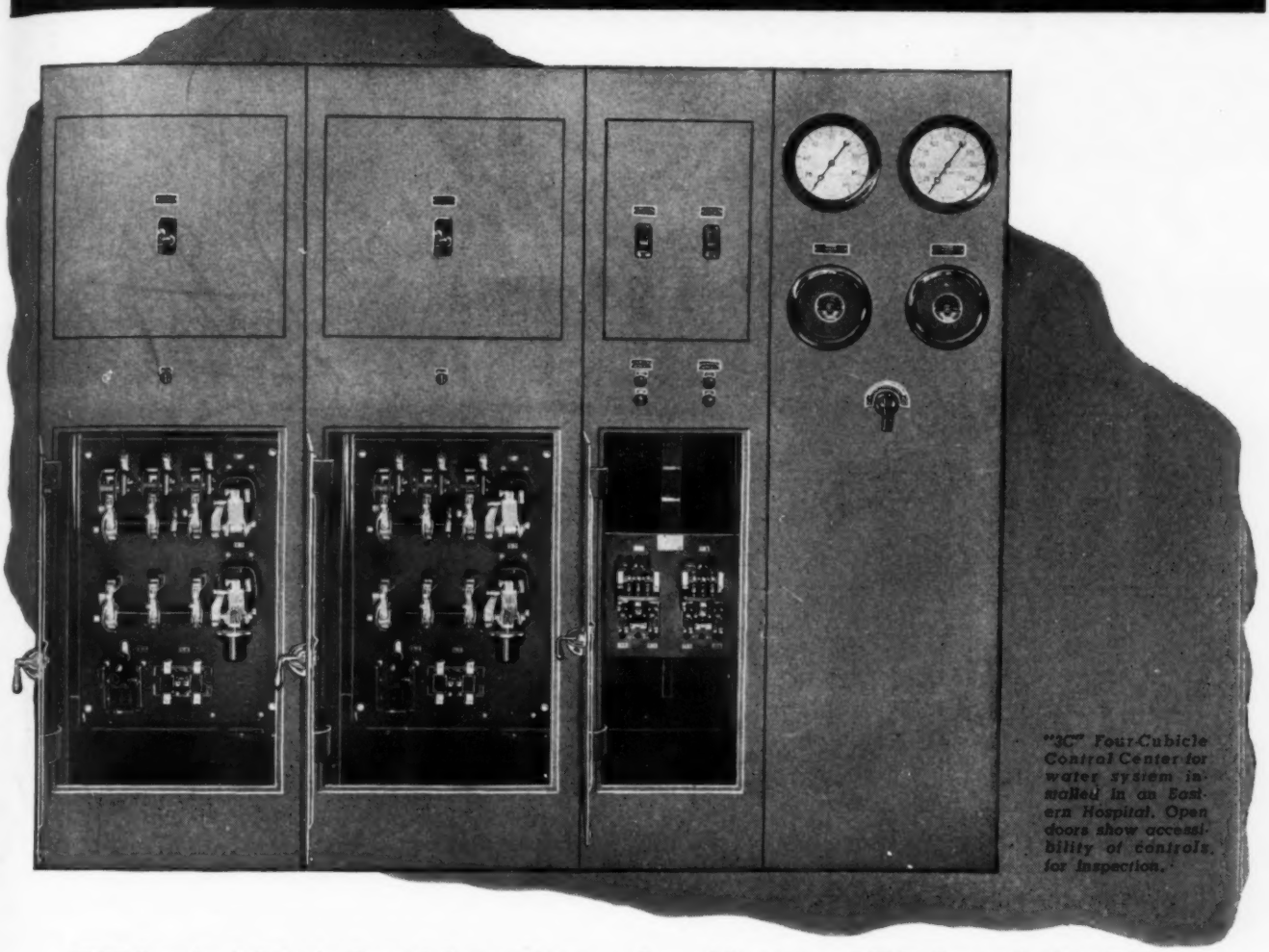
*Name of Water Works Laboratory making this report . . . on request.

NO-OX-ID IRON RUST
REG. TRADEMARK AUG. 27, 1918

The ORIGINAL RUST PREVENTIVE

Dearborn Chemical Company
Dept. Y, 310 S. Michigan Ave., Chicago 4, Ill.
New York • Los Angeles • Toronto

HOSPITAL INSTALLATION SHOWS DIVERSITY OF CUBICLE CONTROL CENTER APPLICATIONS



"3C" Four-Cubicle Control Center for water system installed in an Eastern Hospital. Open doors show accessibility of controls for inspection.

"3C" Standard Cubicle Control Centers have proven their merit in many Municipal Water Works and Sewage Treatment Plants. Their neat, compact, uniform appearance has won favor in every installation. The installation above indicates that these same advantages also apply to commercial and industrial applications where water supply control is required.

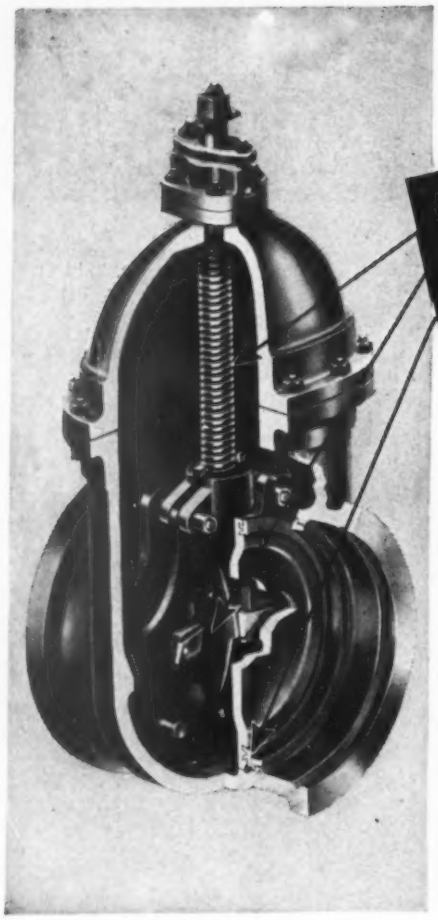
This particular hospital installation for a large eastern institution provides control for two 40 H. P., 216-volt, 3-phase, 60-cycle Cold Water Pump Motors, two 3 H. P. Across-the-line Compressor Motors and also Gauge and Control Cubicle. All cubicles have 12" flood space, dead front construction, easily removable back panels and removable plates on both sides for continuous bus-bar installation and interconnecting control wiring. Provision for locking protects controls against tampering.

Matching cabinets are always available, should additional control be required, assuring a neat, uniform appearance.

Write for "3C" Bulletin 9900, giving complete information on Clark Cubicle Control Centers—including overall dimensions and tables for selecting proper equipment.

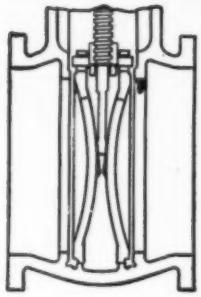
THE CLARK CONTROLLER CO.

1146 EAST 152nd ST., CLEVELAND 10, OHIO • EVERYTHING UNDER CONTROL

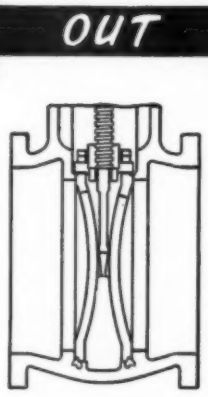


1. Continued turning of valve stem.
2. Brings wedges into action and expands the discs against their seats.
3. After disc travel ceases.

Why SMITH GATE VALVES DO NOT WEDGE PREMATURELY All the Way DOWN



and then OUT



Because of its unique *side* wedging action, the discs of a Smith Gate Valve are not expanded laterally until *after* they have completed their travel and fully cover the ports. Termination of the discs' travel and further turning of the valve stem actuates the wedges and expands the discs. In opening, the action is reversed, the wedges are fully released before the discs commence to travel to an open position.

Smith Gate Valves are made in all types and sizes for manual, hydraulic cylinder, or motor operation and for low—medium—high pressure services.

18

FIRE HYDRANTS
GATE VALVES
CHECK VALVES
INSERTING VALVES
TAPPING SLEEVES AND VALVES
WATER SERVICE BRASS GOODS

THE A. P. SMITH MFG. CO.

EAST ORANGE, NEW JERSEY

FLOOR STANDS
INDICATOR POSTS
TAPPING MACHINES
INSERTING MACHINES
PIPE CUTTING MACHINES
CORPORATION TAPPING MACHINES

All this deflection.....and

NO BREAKS--
NO LASTING LEAKS

Drawing made from photograph of test line.

JUST TO SEE WHAT WOULD HAPPEN, this 80' length of 6" cast iron pipe was set up on trestles and the five sections were joined with *Tegul*-MINERALEAD. 100 lbs. water pressure was turned into the line and trestles were removed allowing the line to sag to a deflection of 7'4" at the center of the inverted arch.

Treat any self-respecting line this way and you're asking for trouble. In *this* case, without any attention, the leaks took up in a short time, demonstrating the sort of good joints you get with

Tegul-MINERALEAD

Later the line was straightened out and the leaks again took up. (No caulking.)

Surely no further comment is needed, except to suggest that this same compound in *your* bell and spigot lines may save you much trouble and expense after those lines are buried in terra firma.

Write for complete information—or contact an Atlas representative at the nearest listed branch office.

Tegul-MINERALEAD

Comes in easy-to-handle 10 lb. ingots. Unaffected by moisture, it can be stored in the open unprotected without fear of rain, snow or flood.

Cannot be "shaken down" by jolting as it journeys from our plant to your job. It melts, pours and sets quickly; needs no skilled labor, caulking or deep bell holes.

Thiokol base reduces initial leakage and helps along quick sealing of any leakage that might possibly develop later. And joints offer super resistance to mechanical and thermal shock.

THE Atlas Mineral

PRODUCTS COMPANY OF PENNA.

MERTZTOWN PENNSYLVANIA

*ATLANTA 3, Ga., 452 Spring St., N. W.
*CHICAGO 1, Ill., 333 No. Michigan Ave.
*DETROIT 2, Mich., 2970 W. Grand Blvd.
NEW YORK 16, N. Y., 280 Madison Ave.
PITTSBURGH 10, Pa., 4656 Old Boston Rd.
ST. LOUIS 8, Mo., 4485 Olive St.

THE ATLAS MINERAL PRODUCTS CO. OF TEXAS, INC. Box 252, Houston 1, Texas

DALLAS 5, Tex., 3921 Purdue St.
*DENVER 2, Colo., 1921 Blake St.
*KANSAS CITY 2, Kan., 1913 Tauromee Ave.
*LOS ANGELES 12, Cal., 172 S. Central Ave.
*HONOLULU 2, Hawaii, U.S.A., Lewers & Cooke, Ltd., P.O. Box 2930
*SALT LAKE CITY 11, Utah, 925 S. 6th West St.
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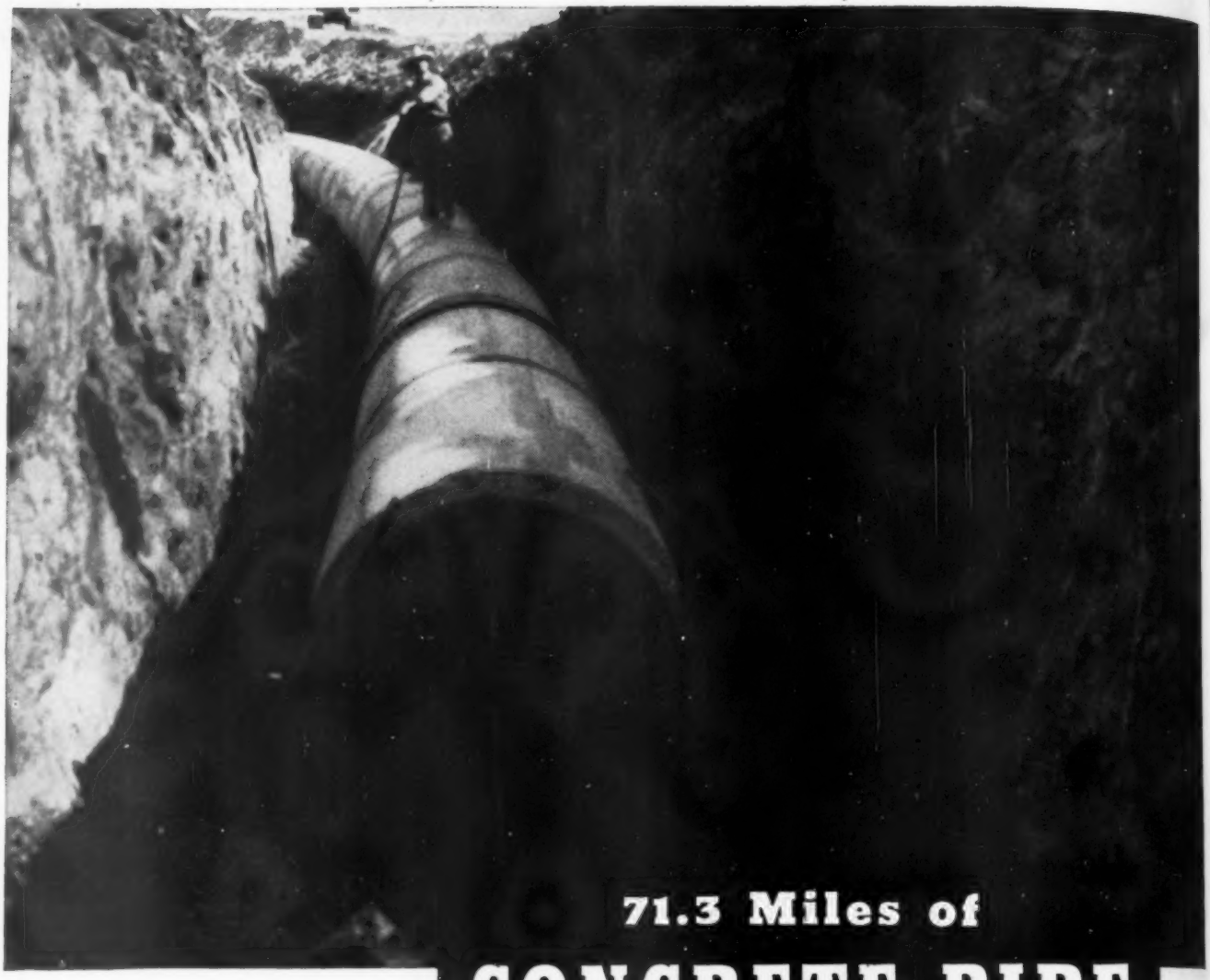

71.3 Miles of
CONCRETE PIPE
in San Diego Aqueduct

54-in. spiral reinforced concrete high pressure pipe being installed for San Diego Aqueduct in a section near Winchester, Calif.

RAPID construction without use of critically scarce materials was a primary requirement for the 71.3 mile gravity flow aqueduct now being built to avert a water shortage in San Diego, Calif.

Reinforced concrete pipe in sizes ranging from 48-in. to 96-in. I.D. are being used to meet this requirement.

The durability, efficiency and economy of concrete pipe for water lines, land drainage, irrigation and sanitary sewers has been demonstrated for more than fifty years.

Technical information on concrete pipe will be furnished without obligation by this Association or any of its members. (List of members on request.)

Construction of this 71.3 mile San Diego Aqueduct is under the supervision of Capt. Alden K. Fogg, Public Works Officer, 11th Naval District. He is assisted by Comdr. R. D. Thorsen, Resident Officer in charge of construction; O. H. Lillard, office engineer; Lt. Comdr. F. M. Hines, northern division, Lt. D. A. Gray, southern division, resident officers. R. B. Ward, Senior Engineer of the U. S. Bureau of Reclamation is consultant on the site.

AMERICAN CONCRETE PIPE ASSOCIATION

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"In our main plant we have 2 Climax R8I 200 H.P. engines . . . direct connected to 4 M.D.G. booster pumps. These engines were installed in 1936 and have been in service ever since. We find them very dependable and satisfactory . . ." Carl Duy, Engineer of Waterworks, Aurora, Ill.

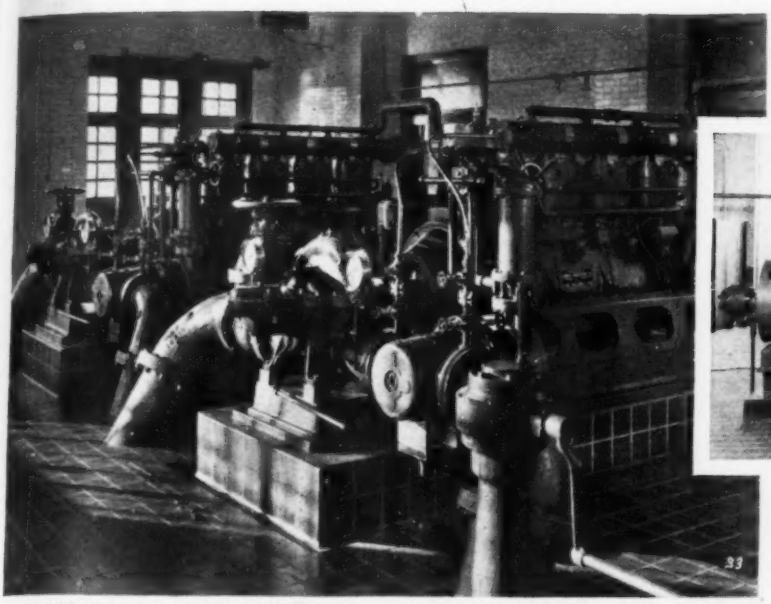
Of Climax R6I in standby service 10 years, John P. Stark, Supt. of Waterworks, Goshen, Indiana, says: "The engine has met every test successfully and has never let us down."

"We have had wonderful success with the Climax standby unit," says J. J. Hail, Supt. Water Department, Dubuque, Iowa.

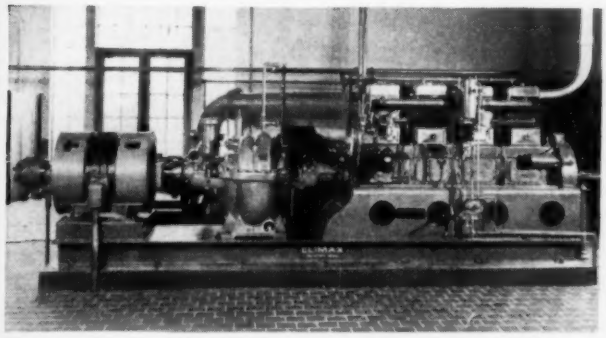
E. B. Lloyd, Chief Engineer and Chemist of Elgin City Water Department says, "The reliability of this (Climax) standby equipment is a factor in keeping our city in a low insurance classification by the National Board of Fire Underwriters and the Illinois Inspection Bureau."

EXPERIENCE OF WATERWORKS ENGINEERS

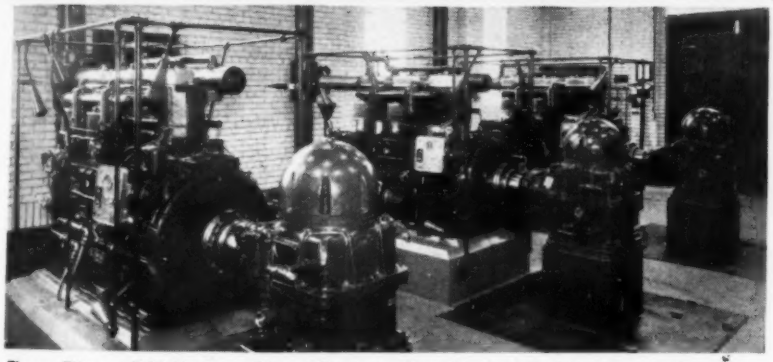
points the way to low cost dependable power for new pumping stations!



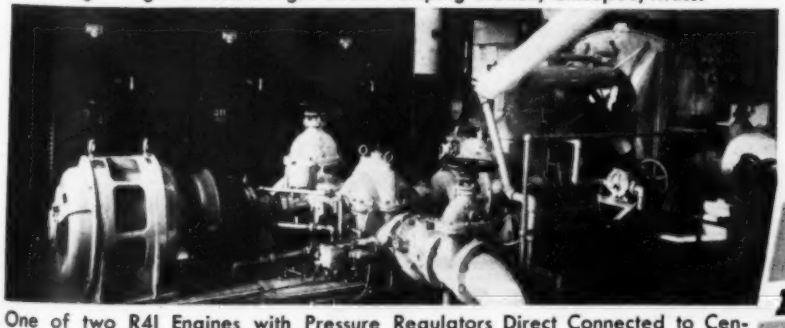
AT LEFT: Two Climax R8I Engines Direct Connected to High Pressure Centrifugal Pumps. Waterworks, Aurora, Ill.



ABOVE: Climax R8I Engine Direct Connected to 200 H.P. Motor Driven Pump. Waterworks, Dubuque, Iowa.



Three Climax R6I Engines Direct Connected to Vertical Turbine Pumps Through Right Angle Gears. Dwight Street Pumping Station, Chicopee, Mass.



One of two R4I Engines with Pressure Regulators Direct Connected to Centrifugal Pumps. Douglaston Pumping Station, Queens, New York.

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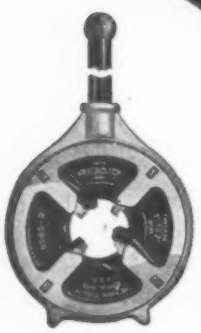

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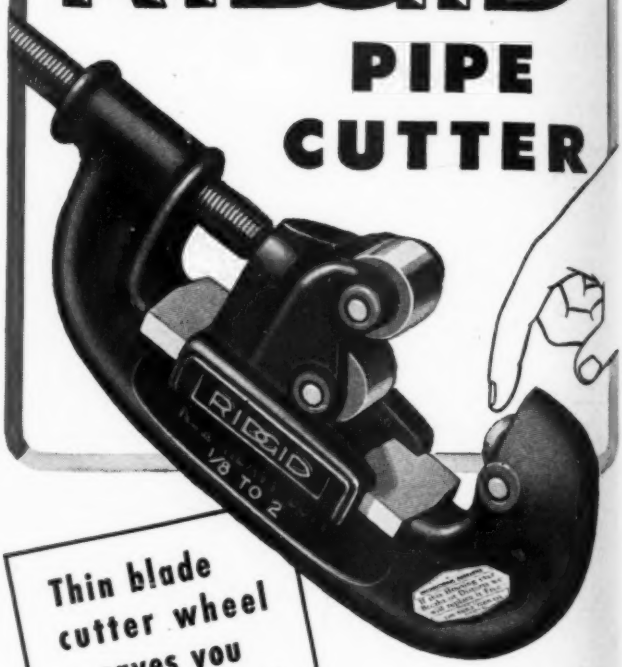

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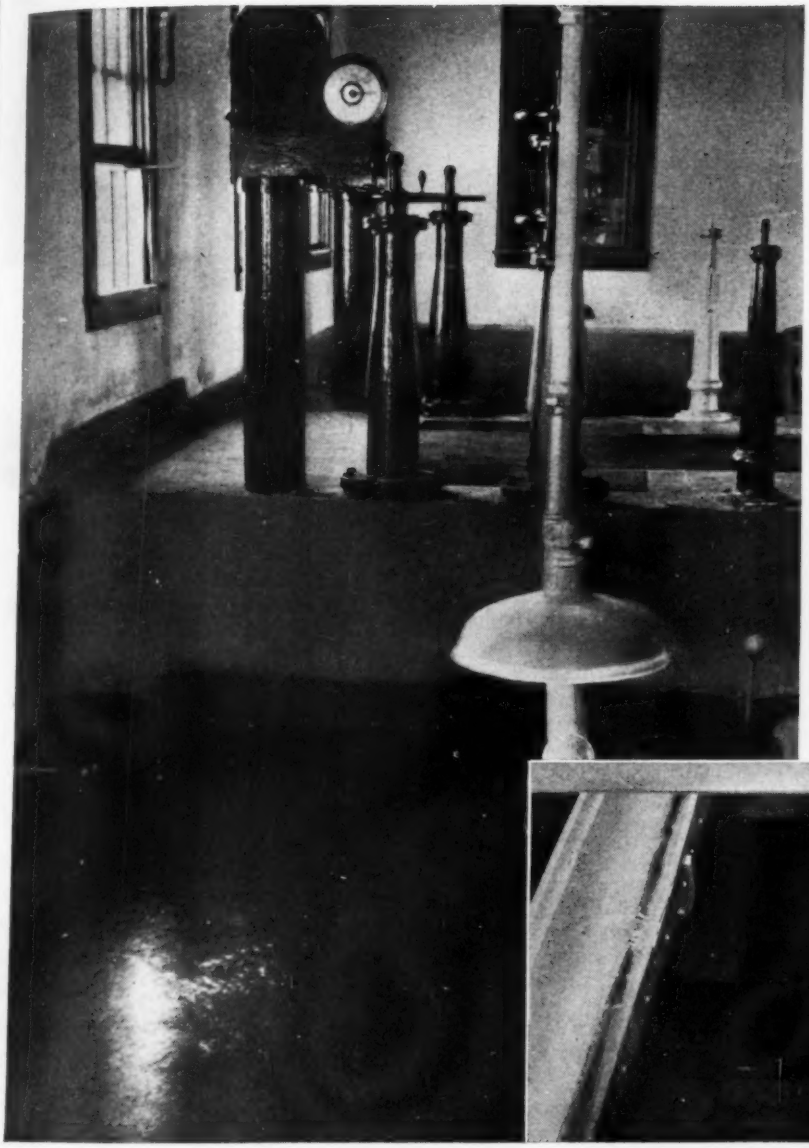

THE water filtration system in Fairport had proven unsatisfactory Installed in 1923, it was up for repair in 1933 and again in 1941. Metal parts such as laterals, spray nozzles and manifolds corroded. Spotty backwash resulted. Replacement was inconvenient and costly.

Officials knew of the claims for ALOXITE aluminum oxide porous plates. They also realized a good way to check these claims was to make a thorough investigation of an installation in operation. That is the straight "show us" thinking behind their inspection of the system in neighboring Lyons.

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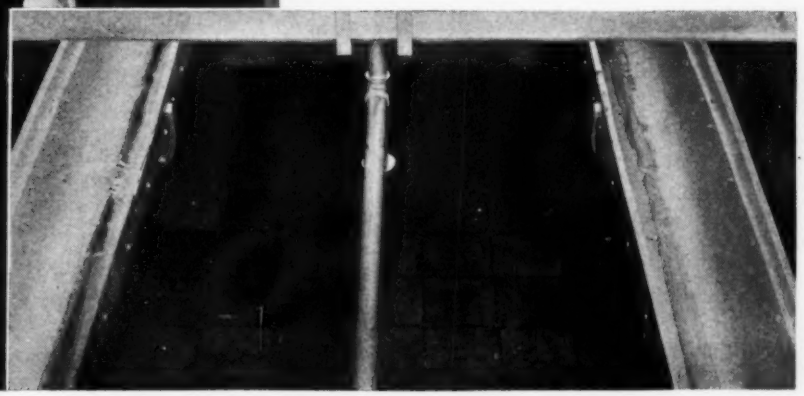

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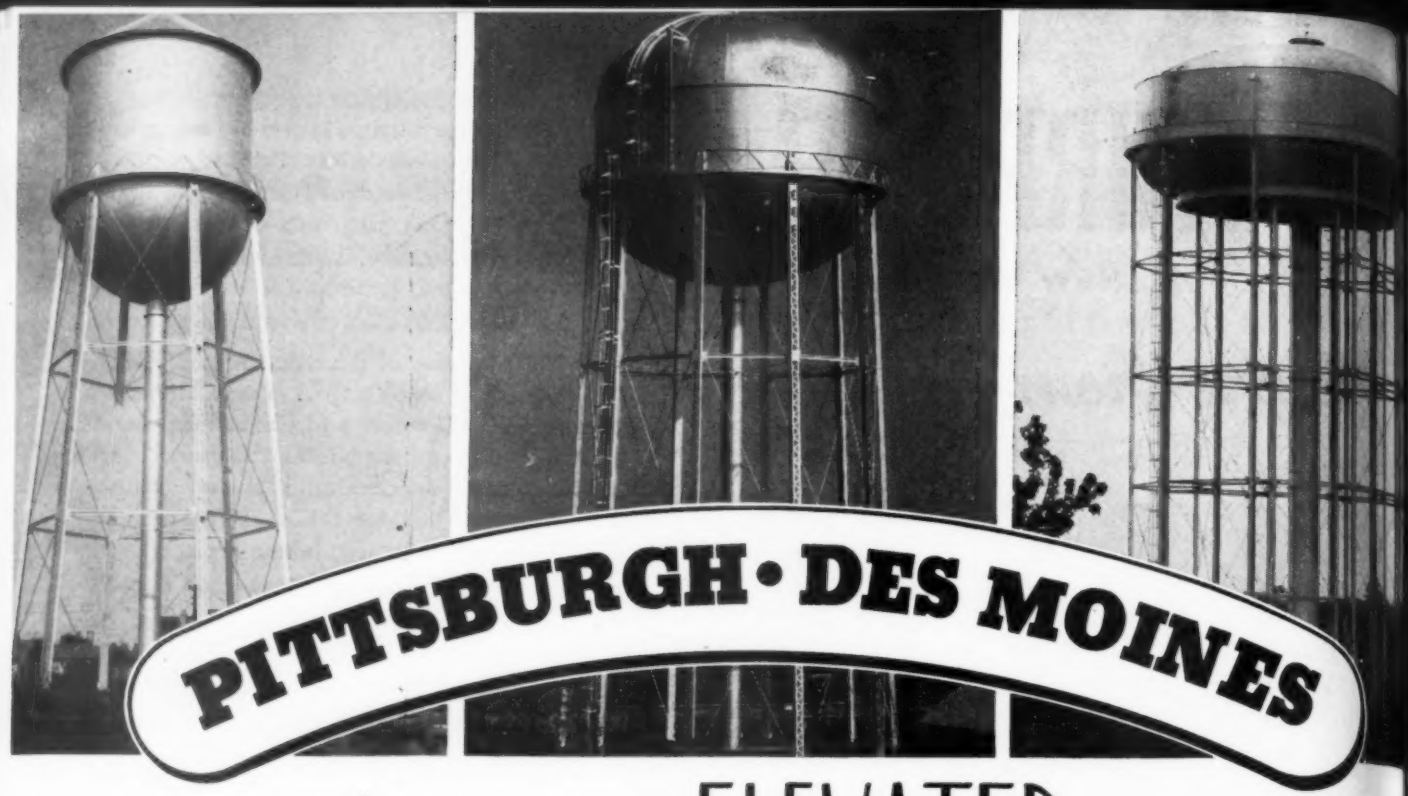

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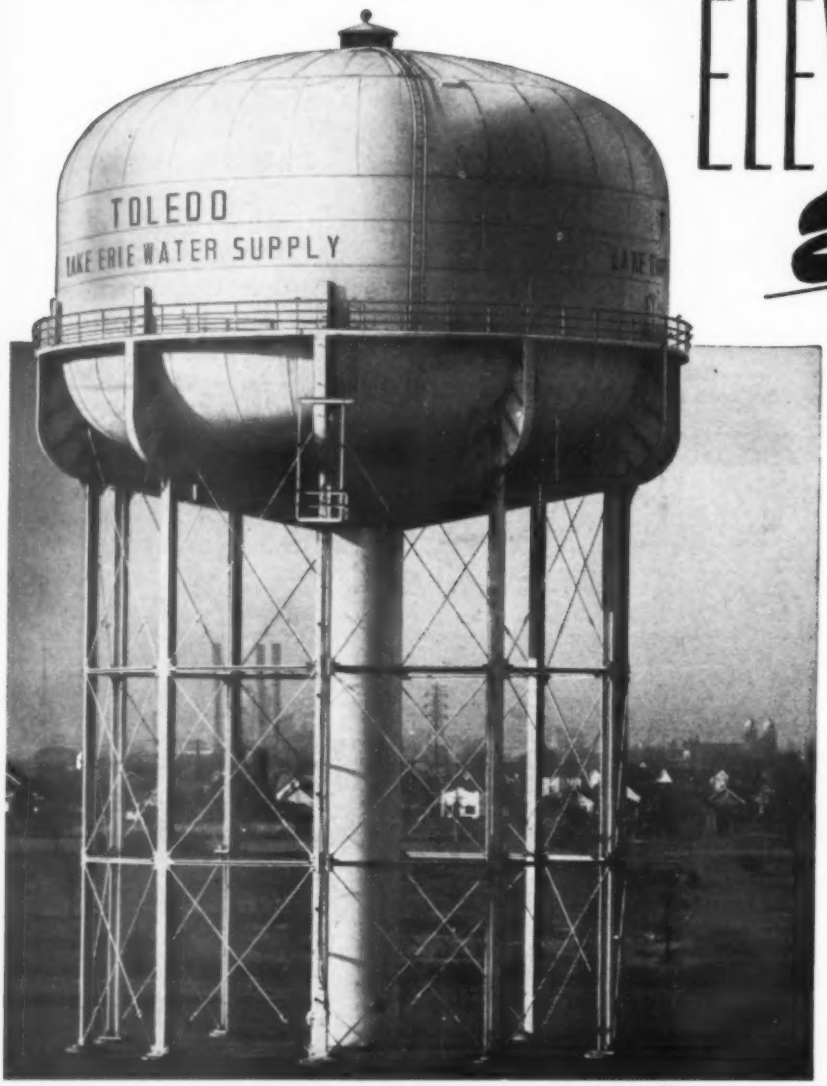

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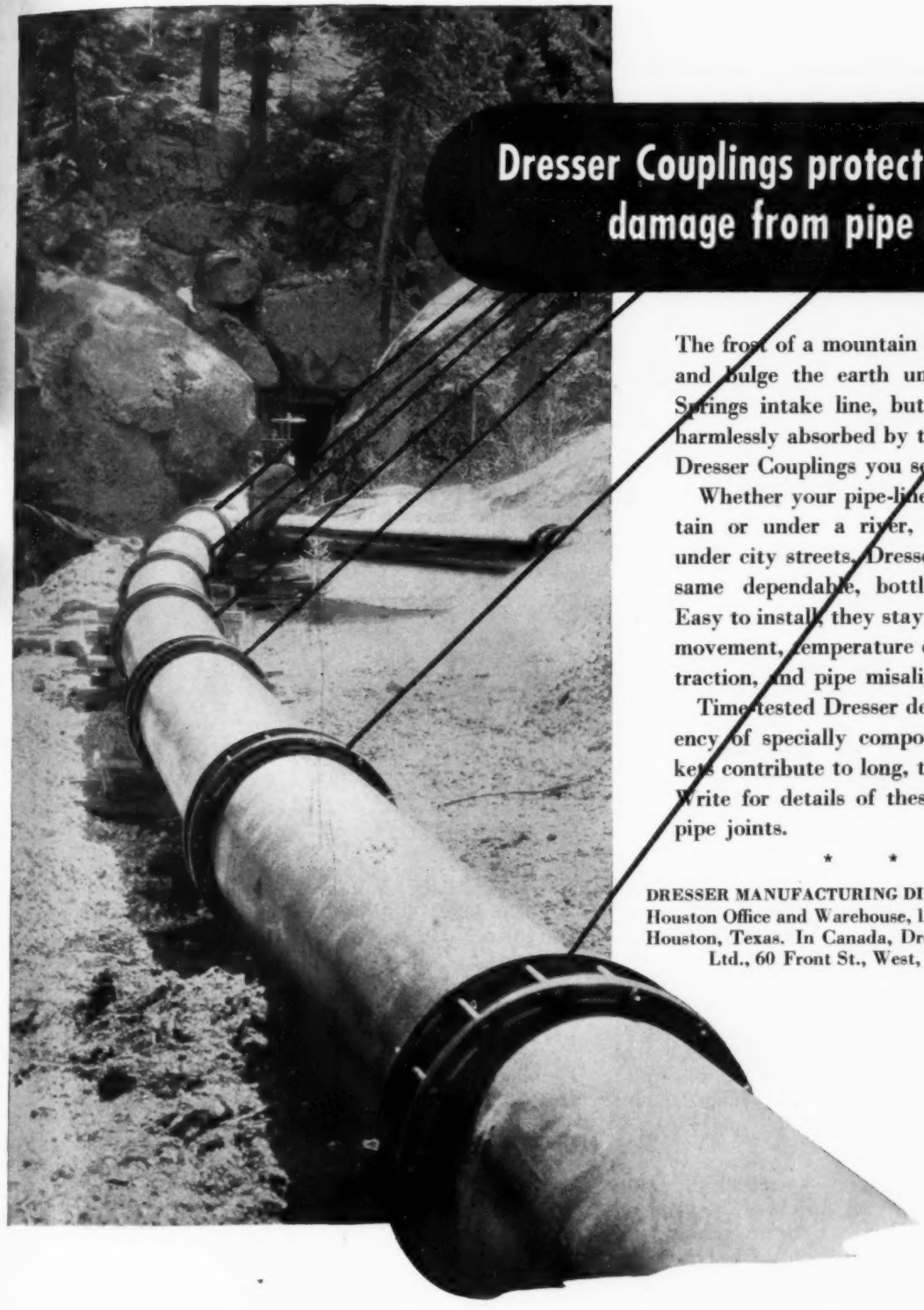

Dresser Couplings protect against damage from pipe movement

The frost of a mountain climate may heave and bulge the earth under this Colorado Springs intake line, but the movement is harmlessly absorbed by the flexible Style 38 Dresser Couplings you see here.

Whether your pipe-line runs over a mountain or under a river, across country or under city streets, Dressers always give the same dependable, bottle-tight protection. Easy to install, they stay tight despite earth movement, temperature expansion and contraction, and pipe misalignment.

Time-tested Dresser design and the resiliency of specially compounded rubber gaskets contribute to long, trouble-free service. Write for details of these widely preferred pipe joints.

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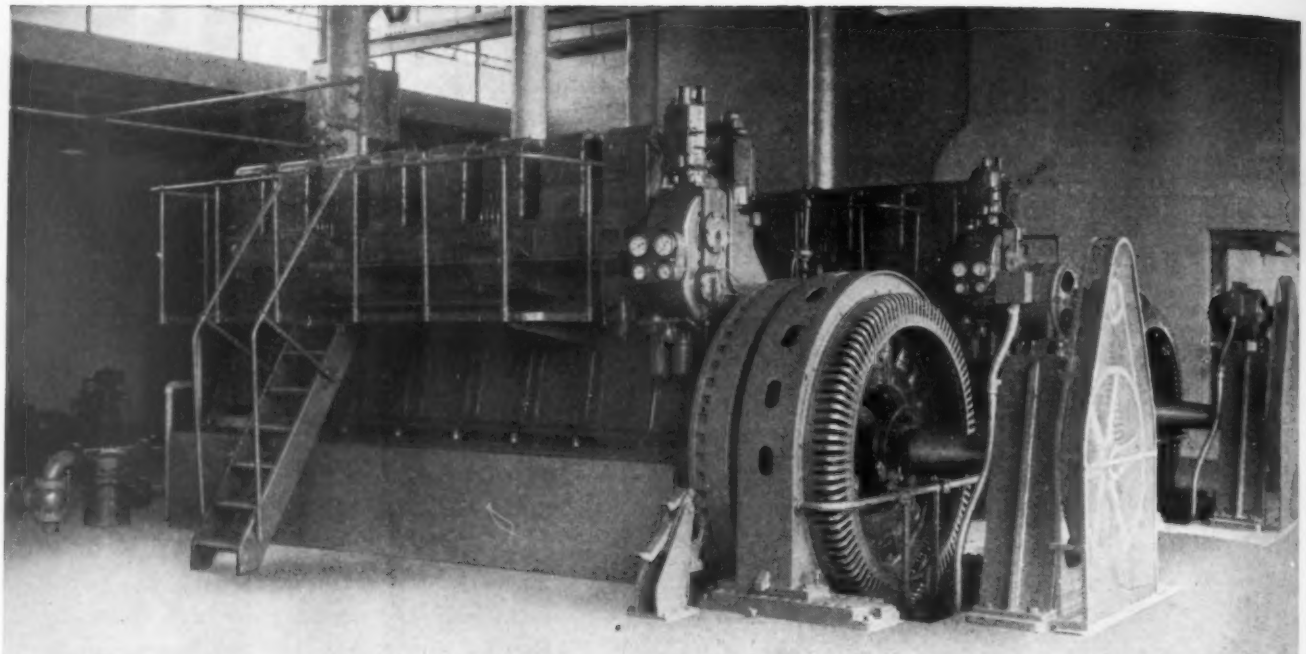

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Naturally, some Diesels are tougher than others. It's no accident. Here are three of many reasons why Cooper-Bessemers of *every* type — for stationary, marine or mobile service — offer exceptional stamina and extra-long-range efficiency for *years* of dependable low cost power.

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No, it's no accident that Cooper-Bessemer Diesels are exceptionally *tough!* The three reasons touched on here are typical of a great many contributing factors. And the end result is always the same — *years* of dependable power at a cost that *stays* low.

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200 women camped on his doorstep

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An accident entirely beyond the water company's control had deprived them of the use of one of their wells. More water was desperately needed, so the superintendent turned to a well which had been abandoned several years before because of the high manganese content of the water.

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Manual de

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1946

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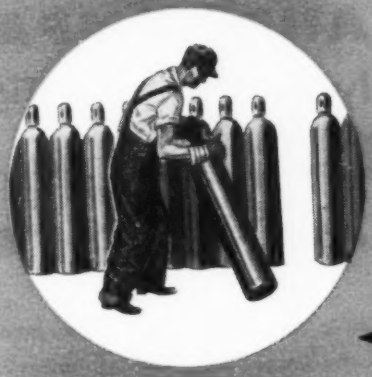

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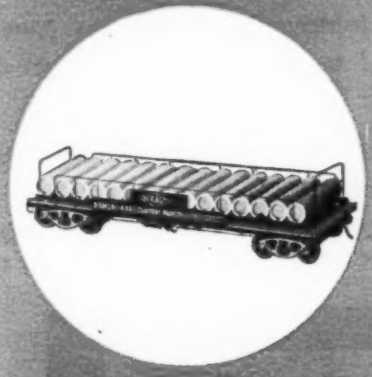

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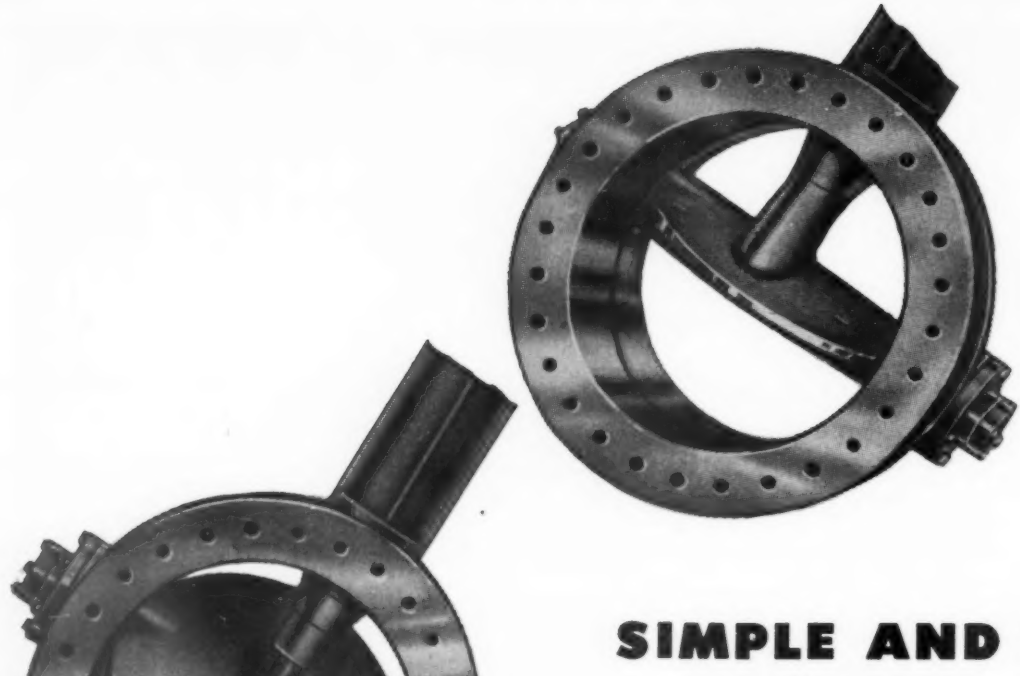

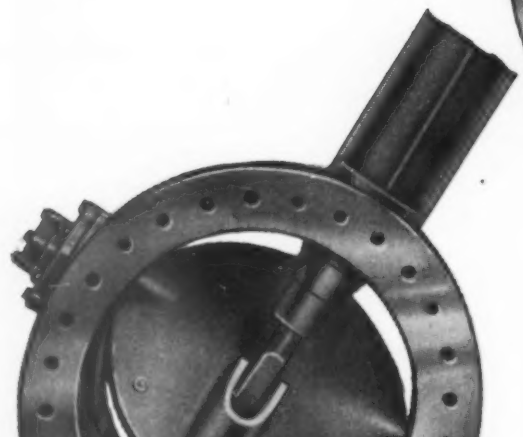

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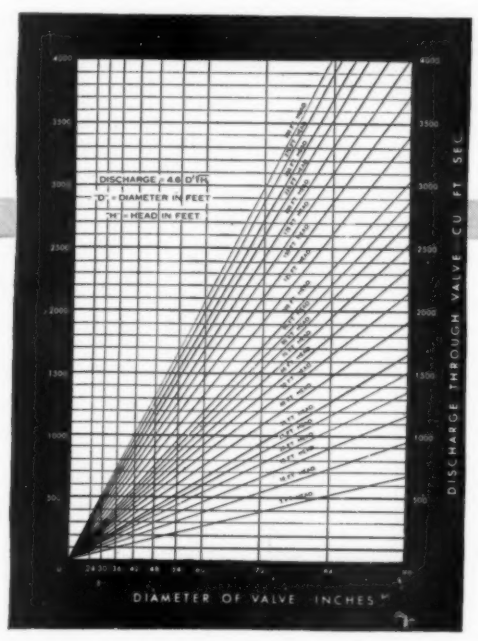

Approximate discharge to be anticipated through a pivot valve under the head available at valve inlet.

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COMING!

Water Supply Developments of the Year—An Annual Review

Has for a number of years been a feature of the January number of *Water & Sewage Works*. For the year 1946 the review is being developed by the President of the Am. Water Works Association, a contributor requiring no introduction to the readers of this magazine who have enjoyed reading earlier contributions from—

WENDELL R. LADUE, Chief Engr. & Supt., Dept. of Water & Sewerage, Akron, Ohio.

Developments of the Year in the Sewage and Industrial Waste Field

Is also an Annual Review regularly featured in the February number of *Water & Sewage Works*. For the year 1946 the review is being developed by the President of the Federation of Sewage Works Associations, a writer of top ability at factual reporting and commenting in a lucid and interesting style—

FRANCIS S. FRIEL, Cons. Engr., Albright and Friel, Engrs., Philadelphia, Pa.

"Cathodic Protection Experience on a Steel Water Supply Main"

Is a story of maintenance experience in connection with the important 8.25 mile Bonita Pipe Line of 28 inch steel pipe serving as a transmission main for San Diego, Calif. Experiences with, and results from Cathodic protection of their 8 mgd. pipe line since 1942 are especially significant. As the result of a careful study, findings with respect to location, characteristics, methods of installation and operation, and the maintenance and renewal of anodes, make possible a number of specific recommendations which comprise a general guide of value to those considering, planning or now operating Cathodic protection systems on pipe lines. This contribution comes from Fred D. Pyle, Hydraulic Engr. of the San Diego Water Dept. The author of the report is—

E. C. ROGNESS, Cathodic Protection Engr., San Diego (Calif.) Water Department.

"Corrosion in Vertical Turbine Pumps"

May be caused by galvanic action water line corrosion, carbon dioxide, or stray currents, but, whatever the cause, it is costly. Both the problem and the remedies are discussed by—

T. E. LARSON, Chemist, State Water Survey, Urbana, Ill.

Gas Engine Maintenance and Operation

Is the story of ten years of successful operation of gas engines using sewage sludge gas at Peoria, Ill. This appraisal of gas engine performance and usefulness, with maintenance and operating experiences, is the contribution of—

L. S. KRAUS, Chief Chemist, Sanitary District of Peoria, Ill.

Operation of Well Supplies

Must receive more than passing attention if we are to preserve our ground water resources. Proper attention to operating records, measurements of static level, drawdown and recovery, as well as a sound maintenance and repair program, are essential to good well operation. Many valuable pointers in the maintenance and operation of wells are given by—

R. W. SIMPSON, Sanitary Engr., Gilbert Associates, Inc., Reading, Pa.

Hydraulics for the Practical Water Works Man

Is a continuing series of articles by Prof. R. W. Angus of Toronto, for many years a teacher of hydraulics and consulting engineer. No. 5 of the series appears in this issue, with others to follow.

VOL. 93, NO. 12 — DECEMBER, 1946

CONTENTS

Gary Completes Cycle on the Grand Calumet 455
By W. W. Mathews
Gary, Indiana

Toronto Meeting Sewage Works Federation, Second Installment 461

Wool Scouring Wastes Treated by New Chemical Process .. 467
By Harry A. Faber
New York, New York
and
Paul F. Howard
Boston, Massachusetts

Kentucky-Tennessee Section Meets in Knoxville 474

Improving Water Plant Operation with Activated Silica Part III 479
By Harold R. Hay
Philadelphia Quartz Co.

Rocky Mountain Section Meets in Romantic Santa Fe 483
As reported by Harry A. Faber
Editorial Associate

Modern Practices in Municipal Water Softening 485
By S. B. Applebaum
New York, New York

Hydraulics for the Practical Water Works Man, Part V 491
By Robert W. Angus
Toronto, Ontario

A Plea for Sound Economy in Stream Pollution Abatement 494
By W. J. Eldridge
Old Hickory, Tennessee

Meetings Scheduled .....Ad. Page 86

"Here and There" with Doc Symons .....Ad. Page 88

Manufacturers' and Equipment News .....Ad. Page 98

Literature and Catalog Reviews .....Ad. Page 109

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WATER & SEWAGE WORKS

VOL. 93, No. 12 DECEMBER, 1946

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GARY COMPLETES CYCLE ON THE GRAND CALUMET

A Review of Five Years of Operating Results and Accomplishments at the Gary, Ind., Sewage Treatment Plant

By W. W. MATHEWS
Superintendent
GARY SANITARY DISTRICT
GARY, IND.

RARELY is it possible for a stream to go through a cycle from natural purity to gross pollution and restoration to a clean condition in a single generation. The sanitary history of the Grand Calumet River at Gary, Ind., affords such a unique record. In a period of 30 years the following changes were brought about with regard to the Grand Calumet:

a. Its dry weather flow increased from practically zero to an average of approximately 600 cfs.

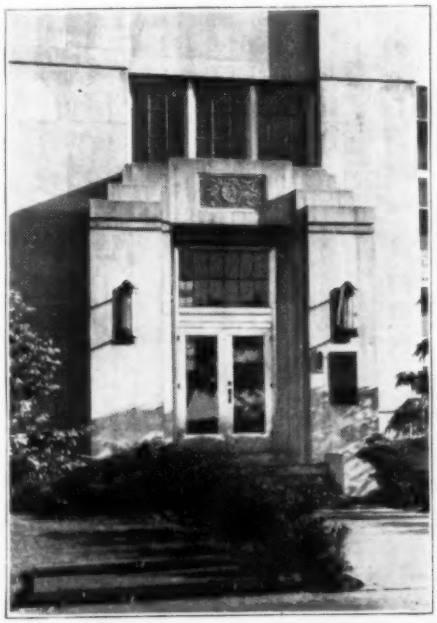
b. Its waters were changed from the clear sand filtered stream of the Indiana sand dunes to a stream carrying industrial wastes and sewage pollution of a community of 100,000 people, with scum banks and floating sludge over its surface.

c. The waters of the stream have now been restored to a condition where liberal dissolved oxygen is always present and exceeds the 5 day oxygen demand of the water.

The first condition was brought about by the construction of the huge steel works which went into operation about 1910 and which in their operations pumped about 600 cfs. from Lake Michigan and discharged it into the head waters of the Grand Calumet River.

The second condition resulted from the very rapid growth of Gary which reached a population in excess of 100,000 in the short period from 1910 to 1940. Its domestic and industrial waste was practically all discharged, without treatment, into the Grand Calumet River.

The Author



Main Entrance
Administration, Pump and Blower Bldg.

The third condition was brought about by the creation of the Gary Sanitary District and the construction of a 40 mgd. activated sludge plant which has relieved the river of its pollution load and delivers an effluent low in suspended solids (averaging approximately 7 ppm.) and low in B.O.D. (averaging approximately 8 ppm.) and with liberal dissolved oxygen at all times.

It is with the hope that the experience at Gary may serve as an inspiration to other cities that the record of Gary is presented. At the close of the war, state health and stream pollution agencies have again found time to survey pollution problems and many private industries and municipalities have been served with "cease and desist" orders relating to the pollution of streams into which their wastes discharge. The Gary experience illustrates what may be accomplished in stream clean-up by the construction and operation of an activated sludge plant.

Very rarely does the construction and operation of one plant give the opportunity to observe and appraise the improvement possible in a stream by complete treatment. Improvement usually is only possible through the construction of several plants. The situation at Gary is unique in that one plant cleans up a section of the Grand Calumet River (within the city limits) and the improvement over those conditions prevailing in the past is quite remarkable.

Administration, Pump and Blower Building
Looking Across Primary Clarifier, Gary, Ind.

Stream Conditions

The author had the opportunity to observe the Grand Calumet River in 1928 while making a D. O. survey from the upstream sewer, westward to the city limits. D. O. was present above the first sewer but throughout the rest of the stream was entirely exhausted. The water flowing in the stream was black and sludge banks were prevalent. In the summer months when the survey was made, anaerobic digestion was active with clumps of sludge being brought to the surface by the entrapped gases. Today the sludge banks have almost entirely disappeared and with no apparent gassing. Dredging in one portion of the stream removed sludge deposits but this is in a relatively short section of that being described.

It is not intended to convey the idea that the stream has been returned to the pristine condition that obtained when the Indians roamed this terrain. There is still some pollution in the stream caused by the discharge of raw sewage from the industries. This will be removed as soon as labor and materials are available to construct sanitary sewer systems and deliver this sewage to the main interceptor of the Gary Sanitary District. One industry in Gary, the American Bridge Company, has already made connection to the Gary interceptor.

At the present time the raw sewage of from 20 to 25,000 employees in industry in Gary is discharged into the Grand Calumet River within the city limits of Gary. The stream today carries some flue dust, slight traces of oil and the sewage noted above, but there are apparently no sludge deposits of any magnitude because gassing has practically ceased and sludge "clumping" has disappeared.

The following table, showing dissolved oxygen at the sampling points as noted, taken with the description given above, gives a good picture of existing conditions in the stream.

TABLE 1
Grand Calumet River Survey—Dissolved Oxygen and 5 Day Biochemical Oxygen Demand

Location	Penn. Railroad ¼ Mile Upstream		Clark Road ¼ Mile Downstream		Cline Avenue 2¼ Miles Downstream	
Year	D.O.	B.O.D.	D.O.	B.O.D.	D.O.	B.O.D.
1928 Average	0	**	0	**	0	**
1941 Average	4.20	7.50	4.30	6.60	3.80	4.70
1942 Average	4.38	4.99	4.34	3.64	4.31	2.71
1943 Average	3.81	3.98	3.90	3.78	4.00	3.33
1944 Average	4.53	4.14	4.65	4.26	4.83	3.12
1945 Average	4.95*	4.59*	5.18*	4.03*	4.96*	3.43*

* 11 months average.
** No B.O.D. determinations made in 1928.

The entire flow in the river, exclusive of storm water runoff, is cooling water from the industries which may vary from 300 to 450 mgd. It is obvious that stream conditions will be further improved when connecting sewers are completed and all raw sewage is brought to the Gary Activated Sludge Plant.

It will be noted from the above table that for the first 2 years the D. O. at the sampling point 2¼ miles downstream was lower than at the point ¼ mile above the plant. This trend was reversed in 1943 and continued through 1945, although there is slight difference in the 1945 determinations. This is probably due to the fact that the river bed is wider and flatter near the downstream sampling point, with conditions more favorable for sludge deposits to form. After 2 years of treatment, with most of the solids removed in the treatment process, the existing sludge banks have either digested or washed downstream. It is interesting to note that almost without exception the averages show increases in D. O. at the various sampling points year by year from the time sampling was started.

The Grand Calumet River is a stream that on account of its location will always be used as industrial outlet. When complete treatment is provided for all the sewage originating in the Calumet area, both sanitary and industrial wastes, D. O. should be present throughout the en-

Aeration Units, Gary, Ind.
Note the Even Air Dispersion from Tubular Diffusers

tire length of the Grand Calumet River. It should be kept in mind that the area covered by the sampling points noted above constitute a relatively short length of stream, but in this length no discharge enters except the final effluent from the activated sludge plant of the Gary Sanitary District. The sampling carried on over the past 5 years, coupled with the contemplated removal of sewage from the stream above the sampling points, indicates that a relatively higher D. O. will prevail in the future than at present.

Activated Sludge Plant Operation

The Gary, Ind., Activated Sludge Plant went into operation in August, 1940. It is the diffused air type, with separate sludge digestion and gas engines provided for driving sewage pumps and blowers. Since this plant has been described in previous articles in this magazine and elsewhere, no detailed description will be given here and the reader is referred to the bibliography at the end of this paper if further information is desired. With the exception of a suburb of Gary, where treatment is by an Imhoff trickling filter plant, all sewage is treated at the Activated Sludge Plant. Annual average flow has varied between 18.83 and 21.50 mgd. Sewers are combined type with connected population estimated at 100,000. Except for pickling liquor which is discharged into the sewer system at intervals of from 1 to 6 days, no industrial waste is treated. The sewage can be classified as an average domestic sewage except at those times when the pickling liquor is being treated. Hydrated lime is used at the source of waste to neutralize the acid so that very rarely is the pH of the iron containing composite raw or clarified samples less than 6.8. With the pH maintained at or above this level, no inhibition of the biological processes is noted.

The preceding statement comparing the Gary sewage to "an average domestic sewage" is quite broad and possibly open to question. Tables 3 and 4 would indicate that the sewage treated was somewhat more concentrated than an "average" domestic sewage. The reason for this apparent discrepancy is that the sewage treated is a mixture of supernatant liquor from the digesters and the flow from the city. Analytical results show that the actual load on the plant in the form of returned supernatant liquor may at times equal that from the entire city of Gary. After correcting the 5 Day B. O. D. for this self imposed load, the average 5 Day B.O.D. per capita per day for 1945 was 0.23 lb. This might indicate that there was some industrial waste in the sewage, since this total is well above the commonly accepted 0.17 lb./cap./day of 5 Day B.O.D. for a domestic sewage. If so, this additional loading must be from several sources for there is no one industry that discharges any known amount of waste. On the other hand, it may be that the connected population is underestimated. Since about one-third of the total sewage treated is ground water, and with the population changing during the war, an underestimate of the connected population seems a reasonable explanation. An analysis made after the 1950 census may make necessary some revision of basic data of previous years.

Blower Room—Gary, Ind.

In foreground—Three motor driven Elliott Centrifugal Blowers of 5000, 7000 *and* 9000 *cfm. capacities. In background—Two Roots-Connersville Blowers of* 7000 *cfm. capacity each, direct driven by two* 300 *h.p. Cooper-Bessemer Gas Engines.*

Judging Plant Performance

In the final analysis the performance of any sewage treatment process is judged by the suspended solids and 5 day B.O.D. in the final effluent. These two quantities are those which most affect the stream below the plant outfall. The solids may cause sludge banks and the 5 day B.O.D. draws on the oxygen content of the stream. The efficiency of any plant is stated in per cent removal of suspended solids and per cent reduction of 5 day B.O.D. While these facts tabulated give an idea of the efficiency of the plant from inlet to outlet, they do not give a complete picture unless compared with the contents of the final effluent.

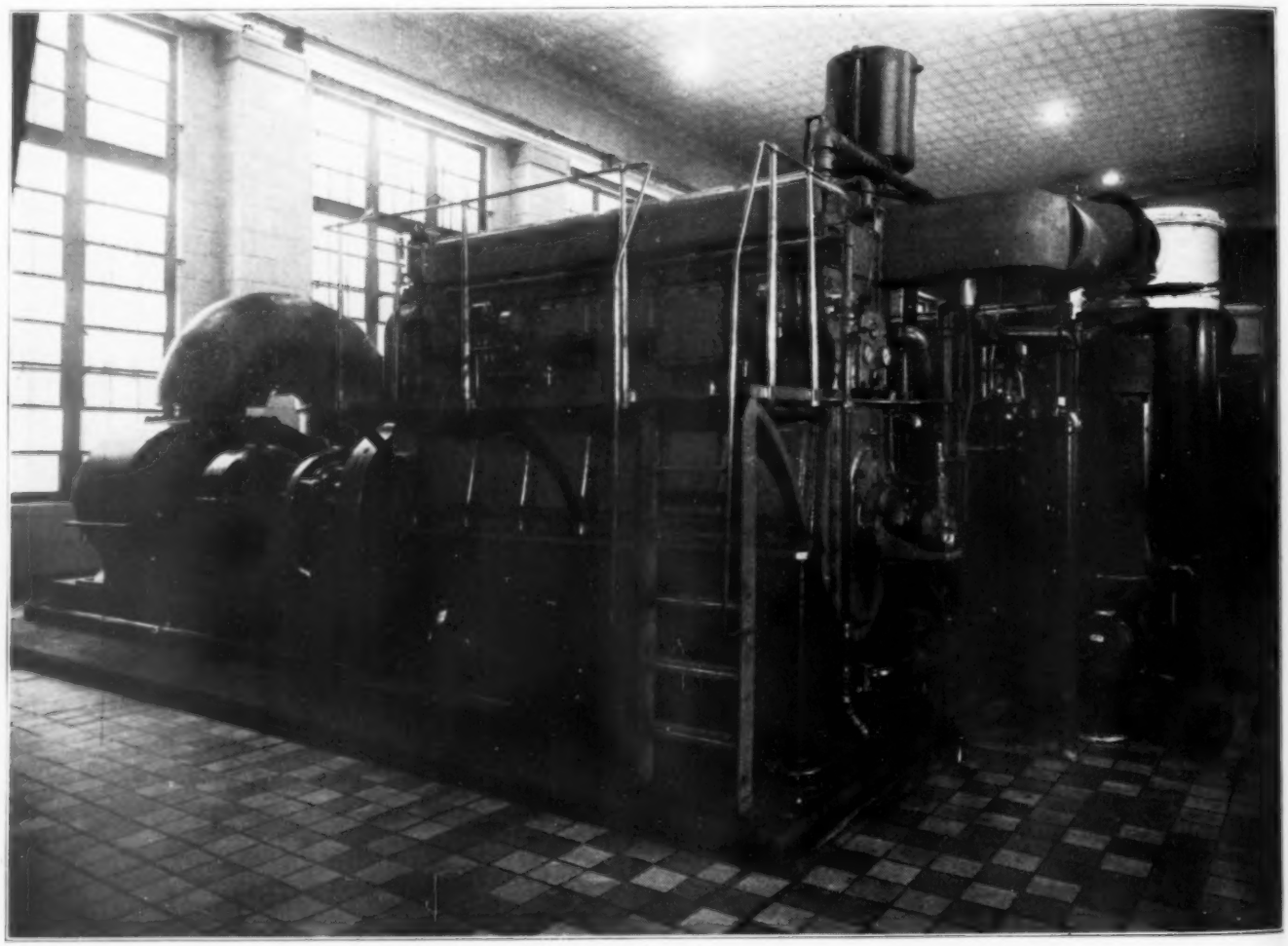
To carry this further, although it is quite elementary, two plants may show an efficiency as regards solids removal of 90 per cent. One may start with 100 ppm. in the raw sewage and produce a final effluent having 10 ppm. The other may have 1,000 ppm. and end up with 100 ppm. They obviously are operating at the same per cent of efficiency but there is no doubt as to which plant produces the better effluent. The same reasoning applies to 5 day B.O.D. Therefore, the experienced operator or sanitarian, before passing opinion on the performance of a plant, always examines the analytical results to see what was in the final effluent and compares this with the indicated plant efficiency. As far as tabulated percentages may be used to indicate the efficiency of a plant, the operator (and plant) treating a weak sewage is at a disadvantage compared to an operator or plant treating a strong sewage. It is assumed here that the two plants being considered are of ample capacity and are being operated properly. Following is a summary showing annual efficiencies of the Gary plant with ppm. of suspended solids and 5 day B.O.D. in the final effluent for the period 1941 to 1945 inclusive.

TABLE 2
Annual Efficiencies With Cost Per Capita and Annual Averages of Suspended Solids and 5 Day B.O.D. in Final Effluent

Year	Effluent Suspended Solids ppm.	Per Cent Removal Suspended Solids	Effluent 5 Day B.O.D. ppm.	Per Cent Reduction 5 Day B.O.D.	Cost per Capita*** Connected
1941	8.20	96.12	8.8	94.31	$0.648
1942	5.90	97.22	7.2	94.72	0.665
1943	10.34*	96.58	9.29*	92.82	0.683
1944	5.13	98.40	6.29	96.42	0.802**
1945	6.25	97.97	9.52	93.92	0.701
5 Yr. Avgs.	7.16	97.26	8.2	94.44	$0.699

*Includes 21 days of Primary Treatment only.
**Includes repairs to floor of Aeration Basin No. 2 and replacement of impellers in gas driven sewage pumps.
***Estimated at 100,000. While there probably was some increase in population during the war period, approximately 15,000 entered the armed services, so total served has been kept at 100,000 as a conservative estimate.

From the table it can be seen that the plant operated consistently over the 5 year period. Contents of final effluents and percentages indicating efficiencies varied only within narrow ranges. The various parts of the plant functioned properly and it was possible to produce a high grade final effluent during the war period when increased quantities of industrial



Close-up of Cooper-Bessemer Engines Driving Roots-Connersville Blowers
(Two 300 h.p. engines produce 14,000 cfm. of air from sludge gas.)

TABLE 3
Suspended Solids and Per Cent Removals, 1941-1945, Inclusive
(Figures Represent Annual Averages)

Year	Raw Sewage ppm.	Primary Effluent ppm.	Per Cent Reduction Clarified to Raw	Secondary Effluent ppm.	Per Cent Reduction Complete Treatment
1941	208.40	112.70	45.90	8.20	96.12
1942	228.80	99.65	55.10	5.90	97.22
1943	301.61	95.39	68.37	10.34*	96.58*
1944	321.12	108.26	66.29	5.13	98.40
1945	307.42	89.01	71.05	6.25	97.97

*Includes 21 days of Primary Treatment only.

waste were discharged to the sewers. It should be emphasized here that at no time was the capacity of any part of the plant exceeded.

Table 3 reveals the amount of solids contained in the sewage and removals in the primary and secondary treatment with per cent reductions. The effect of the pickling liquor (sulphate of iron) on the removal of solids in the primary clarifiers is indicated by the high per cent removals shown in the column headed "clarified to raw." There have been instances on days when iron was being received that the removal of solids in the primary stage was above 90 per cent, and 70 per cent removal was quite common. Primary detention period has varied from 1.91 to 2.18 hours, annual averages.

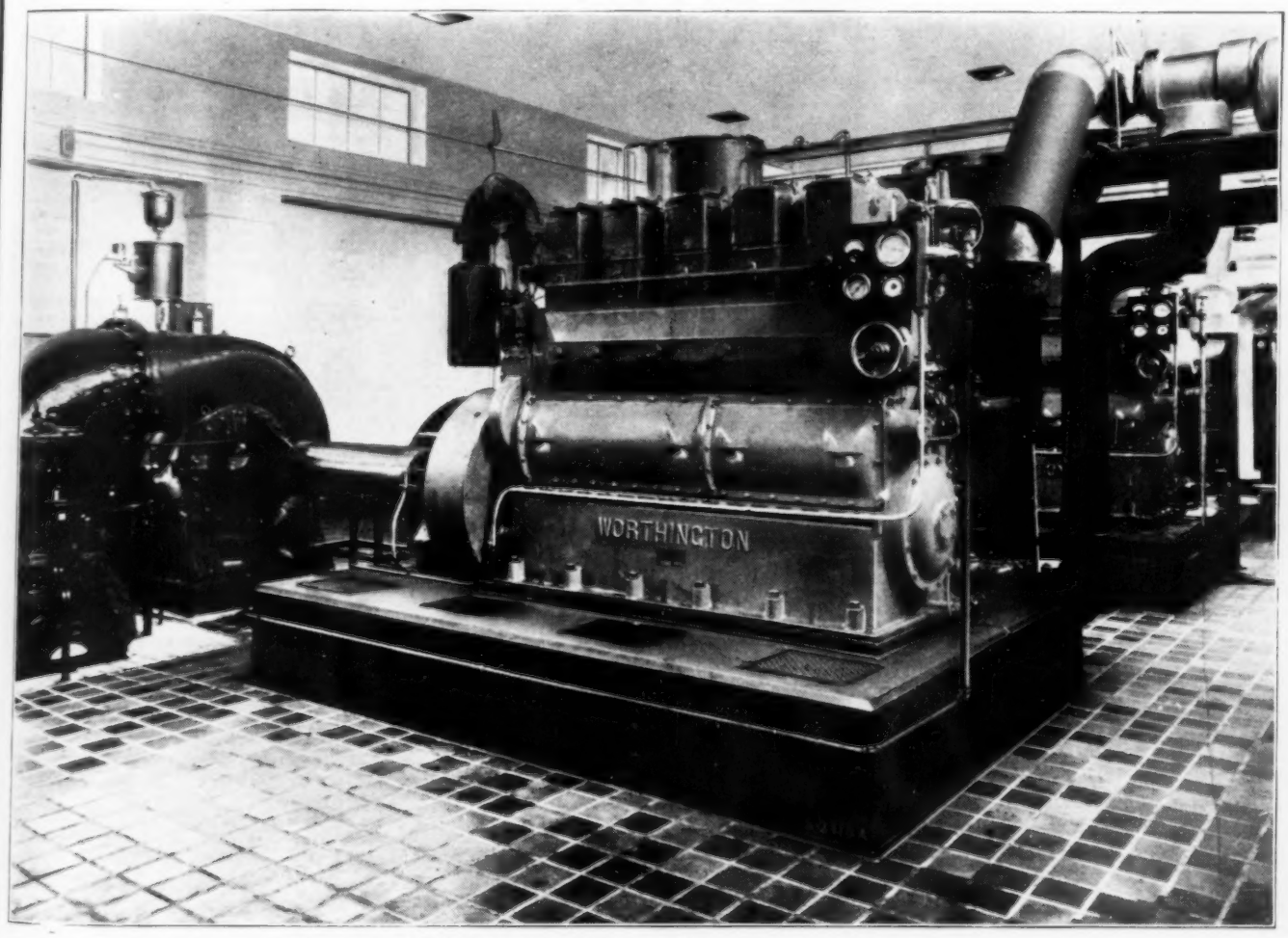
Annual averages of 5 day B.O.D. in raw, clarified and final effluent are shown in Table 4, with per cent reductions in the primary clarifiers and overall treatment. The reduction of 5 day B.O.D. in the primary stage is well above average removal for plain sedimentation and somewhat below that of a chemical precipitation plant. This is mentioned here to call attention again to the effect of the iron bearing pickling liquor on the treatment process.

In contrast to experiences reported by some operators there has been no adverse effect to date from the pickling liquors on the secondary treatment process. The sludge has always settled readily and bulking has not occurred. Bulking was induced as an experiment shortly after the plant was placed in operation by reducing the air blown until D. O. at end of aeration was only 0.4 ppm. When bulking appeared in one of the secondary tanks the rate of return sludge and air applied was increased

TABLE 4
5 Day Biochemical Oxygen Demand
1941-1945, Inclusive
(Figures Represent Annual Averages)

Year	Raw Sewage ppm.	Primary Effluent ppm.	Per Cent Reduction Clarified to Raw	Secondary Effluent ppm.	Per Cent Reduction Complete Treatment
1941	154.80	95.70	38.10	8.80	94.31
1942	132.70	70.60	46.80	7.20	94.72
1943	129.46	63.25	51.15	9.29*	92.82*
1944	175.55	83.78	52.22	6.29	96.42
1945	156.67	71.51	54.36	9.52	93.92

*Includes 21 days of Primary Treatment only.



Close-up of Worthington Engines Driving Crude Sewage Pumps
(Three Worthington engines of 175 h.p. each drive three Worthington pumps of 20 mgd. capacity each.)

and maintained for 24 hours. The bulking stopped and operation went back to a normal basis.

The amount of air blown has averaged between 0.41 and 0.52 cubic feet per gallon of sewage, annual averages. The larger use of air was in 1941, first year of operation.

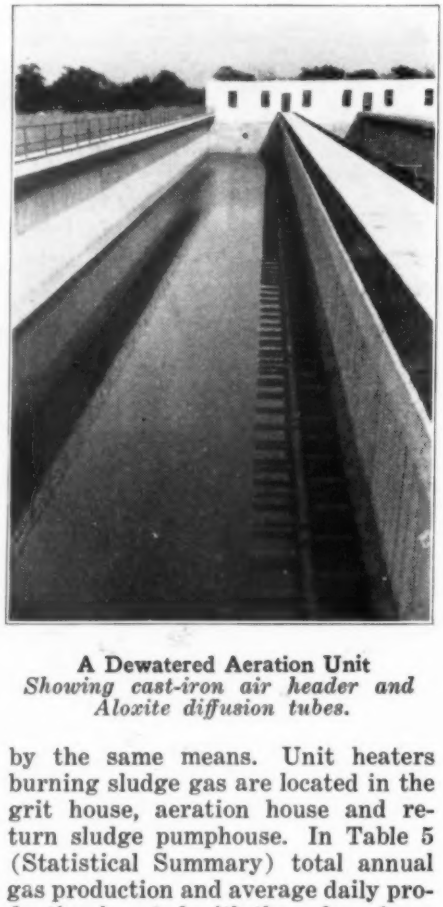
The rate of return sludge, except for the first year when it was 29.70 per cent, has ranged between 32.49 and 36.0 per cent, annual averages. It has been found necessary to keep the return rate *above* 25 per cent to prevent septicity developing in the secondary clarifiers. Per cent of return sludge is computed on the rate of flow of sewage being treated and does not include the volume return sludge. In other words, the figures represent a ratio between volume of sewage treated and volume of sludge recirculated, a 36 per cent return being 36 volumes of sludge returned for every 100 volumes of sewage received at the plant.

Aeration periods (annual averages including return sludge) have been from 3.90 to 4.92 hours. After experimenting for 5 years the mixed liquor solids content is now maintained at between 1,200 and 1,400 ppm. in the winter, and only from 800 to 900 ppm. in the summer. The change is made gradually with changing seasonal temperatures.

Since the plant is designed for 40 mgd. flow with 2 hours' detention in the secondary clarifiers and with the average annual flow approximately one-half this amount, the detention periods are somewhat greater than in the average plant. Similarly the secondary settling rate is lower than usual. On the basis of annual averages, the detention period has ranged from 2.97 to 3.34 hours and the settling rate from 647 to 747 gallons per square foot per day. This capacity, with the clarifying effect of the pickling liquor, has always produced a clear effluent except when changing from one set of aerators to another. At these times the solids contents of the mixed liquor may drop to a level below that required for good clarification and the effluent may present a somewhat cloudy or milky appearance for a short period.

Gas Production and Utilization

Gas production has been maintained at an average higher than was originally anticipated. A mixture of raw and secondary sludge is pumped to 5 primary digesters. Heat is supplied from the gas engines connected to the sewage pumps and blowers. The main building and locker rooms in the garage building are also heated by the same means. Unit heaters burning sludge gas are located in the grit house, aeration house and return sludge pumphouse. In Table 5 (Statistical Summary) total annual gas production and average daily production is noted with the value of gas used for power, water heating and that used for unit heaters, all combined in one total.



A Dewatered Aeration Unit
Showing cast-iron air header and Aloxite diffusion tubes.

It is important to designers, operators and city officials to note the economy that has been effected at Gary through the utilization of sludge gas as a source of power and heating. For the 5 years, 1941 to 1945 inclusive, this gas had a value of $109,808.68. This figure is computed from the heat units used, and from contract prices if similar quantities had been purchased from the local utility under an existing contract. This total of $109,808.68 is more striking if compared with the total expenditures for plant operation over the 5 year period noted above, which amounted to $349,991.52. The latter total is derived from taxation. The value of gas used is 31.4 per cent of cash expended in plant operation and maintenance. Expressed in terms of the tax rate, this is equivalent to approximately 1.59 cents per year. (One cent on the Gary Tax Rate produces about $14,200.)

In conclusion it may be stated that the operation of the Gary Activated Sludge Plant has demonstrated that by the construction and operation of the proper type of sewage treatment plant for a particular location it will be possible to clean up streams and at the same time effect real economy through the utilization of sludge gas as a source of power.

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Statistical Summary, Main Sewage Treatment Plant—1941-1945

Item	1941	1942	1943	1944	1945
Population served (estimated)	100,000	100,000	100,000	100,000	100,000
Sewage pumped, million gallons	7,074	7,563	7,847	6,892	7,120
Average daily pumpage, M.G.	19.37	20.72	21.50	18.83	19.51
Suspended solids removed, lbs.	11,657,667	14,011,858	19,073,538	18,173,772	17,869,388
5 day B.O.D. removed, lbs.	8,276,834	7,927,967	7,869,441	9,734,489	8,730,784
Gas production, cubic feet	53,320,100	57,594,800	52,430,600	56,502,200	56,198,530
Average daily gas produced, cu. ft.	146,156	157,790	143,660	154,378	153,969
Value of gas used	$ 20,877.66	$ 22,535.80	$ 20,946.44	$ 22,661.08	$ 22,784.43
Air blown, million cubic feet	3,351.394	3,329.188	2,954.181	3,195.22	3,171.698
Reduction in suspended solids—%	96.12	97.22	96.58	98.40	97.97
Reduction in 5 day B.O.D.—%	94.31	94.72	92.82	96.42	93.92
COST OF OPERATION					
Per million gallons	$ 9.42	$ 8.79	$ 8.70	$ 11.64	$ 9.85
Per capita (100,000 connected)	$ 0.6482*	$ 0.6652*	$ 0.6827*	$ 0.8023*	$ 0.701*
Per 1,000 lbs. 5 day B.O.D. removed	$ 7.83	$ 8.39	$ 8.67	$ 8.24	$ 8.03

*Cost per capita per year.

TORONTO MEETING SEWAGE WORKS FEDERATION

Second and Final Installment of Report on Record Breaking Convention

THE previous installment reporting the Nineteenth Annual Meeting of the Federation of Sewage Works Assns. at Toronto on Oct. 7-8-9 was published in the November issue. That installment reported the business sessions, the election of officers, awards of honors, the entertainment, the paper on the Toronto Sewage Treatment project, and the symposium on Sludge Disposal.

This installment covers the remaining technical papers and the Operators' Forum.

WASTE TREATMENT

(Reported by Harry A. Faber,* Editorial Associate, *Water & Sewage Works.*)

This session was preceded by the showing of the film, "Clean Waters," produced by The General Electric Co.

De-inking Wastes

"Characteristics and Methods for Treatment of De-inking Wastes" was the title of the paper presented by **W. W. Hodge**, Senior Fellow, Mellon Institute of Industrial Research, Pittsburgh, Pa.

The study of basic data reported by Dr. Hodge was undertaken to provide information on a subject regarding which comparatively few previous data were available. Shortages of wood pulp during the war necessitated the use of large amounts of waste paper in some 40 U. S. mills, but the Canadian problem is less serious because of the greater availability of pulp wood. Each ton of waste paper requires a minimum of 10,000 gal. of water for processing.

There are three general methods of processing employed and all include these steps: General inspection, dusting, shredding, cooking, bleaching, and washing. Different types of de-inking are required for saponifiable inks, non-saponifiable inks, or for mineral oils and carbon. For this purpose, caustic soda, soda ash, detergents, and dispersing agents are used in various combinations, with oxalic acid being employed for special purposes.

Dr. Hodge illustrated treatment studies with a number of lantern slides, but the publication of his paper must be awaited before the complex data can be evaluated. The methods of treatment studied—dilution, coagulation and aeration—will be related to the effect of such wastes on streams. The final paper will include new data obtained during the summer of 1946.

William S. Wise, Chief Engineer, Connecticut State Water Commission, Hartford, Conn., presented the programmed discussion of this paper. Mr. Wise indicated the magnitude of the problem by showing such wastes to have a population equivalent of over 800,000 and by indicating that the wastes from each plant represent an individual treatment problem. Studies at one plant in Connecticut have demonstrated the value of chemical coagulation (using lime and alum), of separate and thorough mixing of chemicals, and of dilution of the wastes wherever possible.

In the general discussion which followed, **A. L. Fales,** Metcalf and Eddy, Engrs., Boston, commented on coagulation results which indicated removals to be high for solids but not for B.O.D. Mr. Hodge re-

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and

James Corcoran
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Ontario

Stuart Coburn
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H. M. Scheak, Chemist
Harris Filters
Jack Roberts, Supt.
Sewage Treatment
Irving Nevitt
Engr. Sewage Disposal
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Lou Fontenelli, Supt.
Sewage Treatment
Rahway, N. J.

Mike Kachorsky, Supt.
Sewage Treatment
Manville, N. J.

Sol Seid, Supt.
Sewage Treatment
New Brunswick, N. J.

ported that the chemical cooking processes resulted in release of proteins, difficult to remove by coagulation. The solids, largely clay, are relatively easy to remove.

Alcohol from Waste Sulfite Liquor

H. G. Joseph, Supt. of the Alcohol Plant, Ontario Paper Co., Thorold, Ontario, read a paper on "Industrial Alcohol Production by the Ontario Paper Co., Ltd., from Its Sulfite Waste Liquor."

This plant, the first of its kind in Canada, was conceived when a shortage in alcohol capacity became evident in 1941-42, and the first shipment was made a little over eight months from the start of construction. Alcohol can readily be produced by yeast fermentation of simple sugars, but alcohol produced by fermentation of other materials must be expensive. In the original process employed, each 1,000 gal. of waste liquor produced 6 gal. of alcohol; in the improved process now used, the same volume of sulfite liquor yields 9 gal. of alcohol.

Only the hexoses, which comprise approximately 2 per cent of the sulfite wastes, are fermentable. The waste is maintained at a temperature of approximately 200° F., urea is added as a source of nitrogen, and the actual fermentation process is carried on at a temperature of 90° F. The proportion of yeast added must be in a definite ratio to the amount of sugar present if fermentation is to be rapid. A centrifugal process has been developed to remove the yeast and recover it for reuse. After fermentation (the volume of each batch is 42,000 gal.) and removal of the yeast, the liquor is distilled. Both ethyl and methyl alcohol are produced, the methyl alcohol (3 per cent of the total) being separated in distillation, and fractionating equipment is employed for concentration.

Mr. Joseph employed lantern slides to show photographs of the plant and flow sheets of the process. Analytical procedures essential to provide close control were described. A reduction of B.O.D. amounting to 43 per cent is attained by this method of treating sulfite waste liquor.

R. G. Tyler, Professor of Sanitary Engineering, University of Washington, Seattle, presented a discussion of Mr. Joseph's paper. The Bellingham, Wash., sulfite waste liquor treatment plant could be designed, Mr. Tyler acknowledged, to profit by experience gained at the Ontario plant. While the basic steps of the process are similar, continuous flow operations are utilized and less manpower is required.

Dr. F. W. Mohlman, Dir. of Labs., The Sanitary District of Chicago, asked about the new magnesium sulfite process, with particular reference to its effect on the B.O.D. of these wastes. Mr. Tyler stated this new process will eliminate practically all of the stream pollution problem. The process, which is patented, will probably be employed only in new plants because existing plants are not suitably designed for its use. A large plant to employ the magnesium sulfite process is now under construction at Longview, Washington.

Stream Sanitation

H. W. Streeter, Sanitary Engineer Director, Water and Sanitation Investigations, U. S. P. H. S., Cincinnati, Ohio, speaking on "Standards of Stream Sanitation," evaluated both opinions and scientific information in an attempt to determine recent trends.

Mr. Streeter noted that the adequacy or inadequacy of standards adopted will be determined by opinions regarding the use of streams. In general, three standards apply: The standards of engineers, the standards of effluent quality, and the standard receiving stream quality.

In the United States the tendency has been toward acceptance of the third standard, since it affords the most direct approach to the problem. This standard gives consideration to public water supplies, agricultural uses of streams, their recreational uses, and the maintenance of fish life. The Ohio River basin studies show the coliform group of bacteria to be of primary importance for standards of quality and standards even more rigid have been adopted by TVA authorities (the latter, however, set up specific standards for specific streams). The high standards will meet requirements for all other water uses except for bathing. Whether high standards can or must be applied in all locations depends on more adequate data.

Mr. Streeter recognized the material increase in efficiency of water purification plants accomplished by prechlorination and by chemical treatment, but did not consider such improved plant operation to justify a lowering of standards of stream quality. "Desirable" standards were recommended in preference to "tolerance" standards, and the hope was expressed that Federal investigation can stimulate the development of such standards.

Milton P. Adams, Executive Secretary-Engineer, Stream Control Commission, Lansing, Mich., in discussing Mr. Streeter's paper, pointed out that no standard by itself can accomplish very much. The principal difficulty experienced in Michigan is to prorate the total stream dilution available among all users. Any unreasonable or arbitrary standards imposed are bound to be wasted effort. While the dictum, "Have 'em put it back as good as they took it out," represents a simple and desirable standard of stream quality, neither domestic nor industrial wastes can be economically treated to meet this standard.

W. S. Wise, Conn., described uniform standards for all states as undesirable. In Connecticut no public water supply is obtained from what is considered a polluted stream. Water supplies for textile industries must be of high quality, but supplies for metallurgical industries need not. These conditions are difficult to reconcile with uniform standards.

Wool Scouring Wastes

"The Hypochlorite Process for Treatment of Wool Scouring Wastes" by **Harry A. Faber,** Research Chemist, The Chlorine Institute, Inc., New York, N. Y.

This distinctly new method, developed recently both for the treatment of wool scouring wastes and for the recovery of a valuable by-product, is fully described in an article by H. A. Faber and Paul Howard, which appears in this same issue under the caption, "Wool Scouring Wastes Treated by New Chemical Process."

The paper was discussed by Joseph Campanella, Chemical Engineer, Fields Point Mfg. Corp., Providence, R. I., who has had personal experience in the development of this process. Mr. Campanella pointed out that the problem of treating these wastes is more nearly one of chemical engineering than one of sanitary engineering. The success reported has been accomplished through integration of the scouring process with the waste treatment process.

SEWAGE SYSTEMS AND TREATMENT PRACTICES

One technical session, under the presiding gavel of J. K. Hoskins, Retiring President of the Federation, dealt with the subjects of

Georgia to San Francisco

F. L. McDonald, Chief Engr. Arkansas Dept Hlth. Little Rock, Ark. and A. L. Bayone, Chf. Engr. District Health Unit Minot, N. D.

Roy W. Garrett Asst. City Engr. London, Ont. and Roy Robertson Supt. Sewage Treatment London, Ont.

Clyde C. Kennedy Cons. Engr. San Francisco, Cal. and R. S. Rankin, Div. Mgr. The Dorr Co. New York

S. W. Kitson, Mgr. Water & Sewage Div. and H. J. Meeker Asst. Vice Pres. Worthington Corp. Harrison, N. J.

A. H. Niles Supt. Sewage Treatment Toledo, Ohio and Van Porter Enloe Supt. Sewage Treatment Atlanta, Ga.

financing sewage systems, British sewage purification practice and the U. S. Army sewage treatment program. This session was preceded by the showing of the film, "Concrete Facts," produced by the Master Builders Co.

Financing Sewage Systems

Under this title, **Francis S. Friel,** Albright & Friel, Cons. Engrs., Philadelphia, and vice-president of the Federation, gave an excellent review of current methods and an evaluation of each.

Construction costs are now high and therefore of great concern to engineers. Bond rates are now low, according to Mr. Friel, who pointed out that this situation is the opposite of a decade ago. Construction costs are now 111.6 per cent above the 1933 level and 40.9 per cent above the 1940 level.

Mr. Friel listed eight common methods of financing sewage systems (sewage plants were not discussed). These are: (1) General obligation bonds, (2) special assessments or special assessment bonds, (3) use of current revenue from existing sources or reserves, (4) revenue bonds or revenue certificates; (5) creation of a special organization or independent corporation (Metropolitan districts or Sanitary districts), (6) temporary loans, (7) combinations of the above, or (8) private sewer companies. Mr. Friel amplified on each of these.

One unusual method of financing is to secure bonds to cover part of the capital cost of construction by revenue from other utilities owned by the municipality and thus reduce the annual sewer rental charge.

The engineer has a responsibility, according to Mr. Friel, to produce a system which will provide service at a minimum cost for construction, operation and maintenance. Those who prepare plans for financing should do no less in devising a method that produces the least burden on taxpayers.

Here are some of the things that have to be done in preparing a financing plan: Hire a bond attorney; prepare ordinances carefully; specify how bills are to be paid; avoid pitfalls in preparation of sewer assessment lists; and establish sewer rentals prior to the issuance of bonds.

On the matter of sewer rental methods and rate schedules, Mr. Friel suggests that they may be based on:

1. Water consumption
2. Fixture count
3. Flat rate
4. Character of property served
5. Number of sewer connections
6. Value of property served
7. Size of water meter
8. Volume and character of sewage or waste

From a survey of 41 communities it is found that 82 per cent have annual charges between $2 and $8; 37 pay quarterly; 21 are based on type of sewer connection, and 19 are based on water consumed.

In another survey, Mr. Friel finds that 48 of 92 communities are financed by revenue bonds; 47 of the 92 render monthly bills, while 26 have quarterly bills; 38 of the 92 base charges on water consumption, 30 use a flat rate, and 13 base charges on the number of fixtures.

As to the matter of financing and the effect thereon of increased construction costs and decreased bond rates, Mr. Friel says that bond rates are at the bottom of a 12 year downward trend. This factor, coupled with the increased importance of the tax exempt feature of municipal bonds and improved financial condition of cities, means that one must state the cost of construction of facilities in terms of the annual debt requirements and not in terms of construction costs. To prove his contention, Mr. Friel cited comparative figures in different years for the rise in construction costs and amortization costs.

Following his presentation, Mr. Friel drew these conclusions:

1. There are ample means available today for municipalities to finance both sewers and plants.
2. Creation of separate authorities solves the problem for many cities.
3. Revenue bonds appear to be the best method and they can circumvent the debt limit.
4. If a city has borrowing capacity, it should proceed at once.
5. Revenue bonds are gaining in popularity but need more enabling laws.
6. The trend today is toward revenue bonds and sanitary districts or authorities.

Montreal to Oshkosh

John B. Harrington Chief Engineer and Robt. G. McCall Associate Engr. W. Va. State Dept. Hlth. Charleston, W. Va.

D. M. Williams Supt. Water & Sewerage Durham, N. C. and Geo. S. Rawlins J. N. Pease Engrs. Charlotte, N. C.

L. N. Hunt Supt. Sanitary Distr. Galesburg, Ill. and R. W. Frazier Supt. Sewerage Comm. Oshkosh, Wis.

W. J. Loney, Engr. Can. Industries, Ltd. Montreal and Harry A. Faber, Chemist The Chlorine Inst. New York

Russell R. Nunn Chmn. Bd. Public Works Ingersoll, Ont. and Chas. W. Riley Mayor Ingersoll, Ont.

7. Collection of sewer rentals on water bills is favored by municipalities owning the water utility.
8. Joint sewage projects for watershed areas are gaining in popularity.

The discussion of Mr. Friel's paper was presented by **F. M. Veatch,** Black and Veatch, Cons. Engr., Kansas City, Mo. Mr. Veatch said that Mr. Friel's paper showed the need for rather general legislation, clarifying the situation since the value of a law is certainly questionable if bonds, issued under its authority, cannot be sold.

Mr. Veatch agreed with Mr. Friel on the analysis of the current situation particularly as regards the combined effects of the high cost of construction and the low cost of financing.

There is little doubt that paying for sewers and sewage disposal in terms of service rendered, rather than mere structural units, should be attractive. Mr. Veatch cited these reasons:

1. It removes sewer costs from the mounting list of expenses that must be paid from taxes.
2. The plan has actual economy as well as tax relief in its favor.
3. The idea of sewer service, if sold to the public, is as attractive as water rents.
4. Charges for sewer service are attractive to health authorities since they offer assurance that sewer systems and sewage treatment plants will be continued under favorable conditions of operation and maintenance.

The outstanding feature of existing rates is their lack of uniformity as regards bases and objectives as well as absence of any common ground for comparison.

Mr. Veatch pointed out that Friel's eight criteria in common use did not include a rate base predicated on investment in property used or useful in service, nor does that list include a determination of rates based on cost of service.

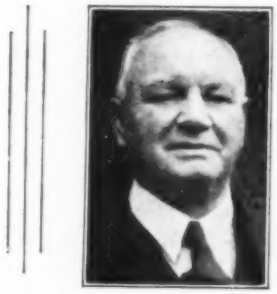
Sewage rates are now where gas, water and electric rates were 50 years ago, according to Mr. Veatch, who went on to say, "No matter what you call a sewer rate, it means, if adopted, that the system is to be operated as a revenue producing utility, rather than an article of public property."

Mr. Veatch cited some special systems of sewer service rates, and concluded his discussion with a plea for a Federation Committee to undertake to study sewer rental systems and evaluate them.

British Practice

The paper by **John Hurley,** Gen. Mgr., Sewage Purification Department, Tettenhall, Wolverhampton, England, and President of the Institute of Sewage Purification, England, was read by **Dr. F. W. Mohlman,** Director of Laboratories, Sanitary District of Chicago, who also was the scheduled discussor of the paper.

Mr. Hurley's paper described present conditions as still a situation of make do and mend. England has suffered the penalty of pioneers



Operator's Forum Moderator
*H. S. Nicklin**
City Engineer
Guelph, Ontario

*(*Retiring president of the Canadian Institute on Sewage and Sanitation, and present chairman of the Canadian section of the American Water Works Assn.—honors enough for one man, but deservedly placed.)*

—the equipment is old and out of date.

The paper commented on screening and grit removal; chemical precipitation and flocculation and primary sedimentation in which detention periods are usually 6 to 8 hours (formerly 10 to 15 hours) and the sewage is generally stronger than in America. Also discussed were activated sludge and trickling filters.

Concerning the former, Mr. Hurley mentioned four types of aeration: mechanical (Simplex Spinner), the Haworth type, the Hartley Spiral flow, and the Kessener Brush aerator. Trickling filters in England may be double, alternating, recirculating, enclosed aerated, or the cyclo-nitrifying filters, a combination of activated sludge and high rate filters.

Mr. Hurley believes that activated sludge followed by trickling filters produces the best effluent, but points out that whichever process is placed first does the best work and that getting the tail load out is the most costly.

According to Mr. Hurley, the two main trends of sewage treatment in common with U. S. practice are intensification of treatment and mechanization.

In discussing the paper, Dr. Mohlman pointed out that the longer detention period in Britain has been a superficially important difference between British and American practice. Considering that the per capita British flow is but 50 to 60 U. S. gal. per day, it is obvious why British sewage is so much stronger. The longer detention periods lead to some septicity. Dr. Mohlman says the trend in both countries is toward shorter periods brought on by the desire to get the sewage through the plant before it smells; mechanical removal of sludge helps.

There is a more conservative policy in England—even the high rate filters are slower than their counterparts in this country. American practice with strong sewage shows a trend toward multiple filters with roughing filters as the first stage.

Dr. Mohlman cited results of trickling filter operation in military installations as shown in the accompanying table.

The data in the table indicate that regardless of type of filter the efficiency drops off when loadings go above 700 to 1000 lb. of B.O.D. per acre foot.

Dr. Mohlman closed his discussion with the comment that "Mr. Hurley does well to call attention to the fallacy of estimating the cost of removing so many pounds of B.O.D., whether head or tail end of the process; in short, the cost depends on the quality of effluent sought.

Operating Results—Military Trickling Filter Plants

No. of Plants	Group Designation	B.O.D. Load Range Lb./Acre-Ft.	B.O.D. Removal — % Efficiency: Filters Plus Sec. Settling	B.O.D. Removal — % Efficiency: Over All Plant
4	Deep—No Recirc.	253- 429	86.9	92.7
4	Deep—Recirc.	245-1170	85.7	90.8
8	Two Stage	192- 930*	66.5*	90.2
4	Shallow—Recirc.	705-2080	81.7	88.1
4	Deep—Recirc.	1190-1950	78.7	87.5
3	Deep—No Recirc.	720-2130	75.7	82.8
3	Deep—Recirc.	2520-5750	70.3	78.3
4	Shallow—Recirc.	2370-8250	70.1	74.8

*First stage.

Army Sewage Treatment Program

The entire September issue of *Sewage Works Journal* is devoted to the report on the Army Sewage Treatment Program and results obtained in the operation of army post sewage treatment plants. This is the report of the subcommittee on Sewage Treatment of the National Resources Committee.

The subcommittee report was prepared under the direction of **Harold A. Thomas, Jr.**, Asst. Prof. of Sanitary Engineering, Harvard University, Cambridge, Mass. Prof. Thomas briefly reviewed the report at the Federation meeting.

The survey covered 56 scattered plants, 30 of which were large and 30 of which were small (one mil. gal. per day or less). Most of the plants were underloaded. The sewage in the plants was very like that from normal municipalities, except perhaps for a slightly higher grease content. The B.O.D. of the sewage averaged 0.19 lb. per day per man, and the suspended solids averaged 0.15 lb. per day per man.

Some considerations of the applicability of the B.O.D. test were raised inasmuch as K values for the B.O.D. curves were found to vary from 0.1 to 0.3.

Evaluation of filter operation was given considerable attention, and the comparisons were made on the basis of effective volume of filter, a concept that included the effect of recirculation. Nitrification was not found in high rate filters, but was likely to be found in low rate filters. Another concept was the determination of B.O.D. removal efficiency in pounds per 1000 sq. ft. of surface hours.

In discussing this paper, Dr. Rolf Eliassen, Prof. of Sanitary Engineering, New York University, said that the most important results obtained and recorded are the results on high rate trickling filters. The application of mathematics to the study of filter performance was also commended by Prof. Eliassen.

In the discussion from the floor, Isador Mendelsohn, San. Engr. in the Corps of Engineers, said the report deserved praise but that it also must be criticized, and he listed and elaborated on 11 points of criticism. Among the criticisms were the lack of conclusions, the lack of data on design of sludge beds, the lack of designs for the construction of sewage treatment plants for future wars, and so forth. Prof. Eliassen replied to many of the criticisms pointing out that the report was a survey of plants as they were operated during the immediate past war, that sludge bed design was unimportant to the report, and that it was not intended that the report set up design criteria for any future war which irresponsible minds were already planning. Several others also made comment on the report, its criticisms, and the implications of the criticisms.

E. J. M. Berg
Supt. Swg. Trtmt.
San Antonio, Tex.

T. C. Schaetzle
Supt. Swg. Trtmt.
Akron, Ohio

L. R. Howson
Cons. Engr.
Chicago

Stanley Shupe
City Engr.
Kitchener, Ont.

W. D. Hatfield
Supt. San. Distr.
Decatur, Ill.

W. M. Veitch
City Engr.
London, Ont.

Sol. Seid
Supt. Swg. Trtmt.
NewBrunswick,N.J.

Linn H. Enslow
Ed. "W. & S. Wks."
New York

Contributors to Operators' Forum Discussion

THE OPERATORS' FORUM

(The last half of this session was reported by Harry A. Faber,* Editorial Associate, *Water & Sewage Works.*)

Activated Sludge Problems

On the problem of *Sludge Bulking*, **Roy Robertson**, Supt. of London, Ont., said they used chlorine and also lime. **L. S. Kraus** of Peoria said he considered sludge to be bulking when it went over the weir, and that this usually happened when the Sludge Volume Index was over 350. **E. J. M. Berg**, Supt., San Antonio, claimed there is a difference between a gas-lifted blanket and bulking that occurs when the plant is overloaded; that is when both the air capacity and settling capacity are too low.

Bulking will be caused by too much returned supernatant liquor or shock loads from slaughter houses and the like. Mr. Berg returns sludge to the extent of 10 to 15 times the suspended solids content of the sewage and uses chlorine according to Tapelshay's formula to control bulking.

Frank W. Jones, Cons. Engr. of Cleveland, described a small plant properly designed that still had feathery solids going over the weir, and a sludge blanket that carried

*Research Chemist, The Chlorine Institute, New York City.

D. M. Williams
Supt.
Water & Sewage
Durham, N. C.

Reuben F. Brown
Supt.
Sewer Maint'nce
Los Angeles

Stan Mogelnicki
Supt. Waste Disp.
Dow Co.
Midland, Mich.

A. L. McPhail
Supt. Water
St. Catherines, Ont.

C. W. Klassen
Chief Engr.
State Dept. Hlth.
Springfield, Ill.

Los Angeles to Durham

high. Jones asked if it wasn't after long periods of drouth that chlorine to control bulking did not work. **Dr. W. D. Hatfield** of Decatur, Ill., described how loadings in his plant were calculated on the basis of 1000 cu. ft. of aeration capacity.

As to the relation of air requirements to the B.O.D. of the sewage, **Stanley Shupe,** City Engineer of Kitchener, opened the discussion with the statement that it was difficult to make such a calculation when mechanical aeration is used. **Dr. F. W. Mohlman,** Dir. of Labs., Sanitary District of Chicago, said that "cubic feet of air used per pound of B.O.D. removed" was a very useful figure in the operation of a plant, but that the values varied for different plants, as shown by Chicago results, where the value is 500 at North Side Plant and 800-900 at the Southwest Plant. Another useful value is "pounds B.O.D. removed per cu. ft. of tank capacity." Dr. Mohlman emphasized the fact that the D.O. content at the end of the aeration tanks should never be allowed to drop below one to two parts per million.

Mr. Berg of San Antonio said that he found it necessary to use 900 cu. ft. of air per pound of incoming B.O.D. in order to obtain an acceptable effluent, and that it was harder to treat a high B.O.D. than a low one.

Prof. Don E. Bloodgood of Purdue University pointed out the fallacy of taking the average D.O. in an aeration tank. Dr. Hatfield of Decatur, Ill., responded that the D.O. at the end of the aeration tank was a good control index, but that it was quicker to take the D.O. at the one-third point from the influent every two hours and to maintain 1.5 to 2.0 ppm. of D.O. at that point.

As to *Costs of Operation,* **George Phelps,** Engr. of Sewers, Toronto, said $1 per capita per year was an average, with 65 per cent charged to labor, 11 per cent to fuel and power, 18 per cent to supplies, and 6 per cent to engineering. Everette H. Munro of York, Ont., reported their costs to be 66 cents per capita per year, without digestion.

Trickling Filter Problems

Trickling filters are preferable to other treatment when industrial wastes are present or when seasonal loads are highly variable, according to **R. V. Anderson,** Cons. Engr., of Toronto. **L. R. Howson,** Cons. Engr. of Chicago, speaking on this topic, remarked that each plant should be tailor made for the problem involved, the requirements of treatment, and the cost. Trickling filters are best for wastes of high concentration and variable load. Trickling filters won't go dead; they only drop in efficiency when the load is increased. They are especially good on packing house wastes.

The trickling *filter fly problem* and nuisance can be met with ⅜ to ½ ppm. of D.D.T. in the total flow, according to **T. C. Schaetzle,** Supt. of the Akron, Ohio, Sewage Plant, who has done considerable experimentation on the use of this insecticide for the control of these flies. At present it looks as though treatment every week is necessary; too much must not be added as it causes undue sloughing of the filter growth.

R. W. Simpson, San. Engr., Gilbert Associates, Reading, Penna., reviewed briefly the experimental work he did at Keesler Field during the war and discussed the costs of treatment, do's and don't's of application and good results obtained.

Sludge Disposal Problems

"Glass-Over" sludge drying beds in Canadian practice appears to be generally unsatisfactory. At the North Toronto plant this type of bed has proven so expensive that they would not again be installed. While glass-over beds were built in 1930 at the East York plant, digested sludge is now removed by tank truck and the liquid sludge is used as fertilizer. For the United States, glass-over beds have proven so little superior to open beds at Jackson, Mich. (the ratio of dryings cited was 165 on covered to 156 on open beds), that the glass-over structures have been sold. Practice at Durham, N. C., was cited as a happy medium; there the beds are covered but not enclosed, and are provided with warming radiators beneath the sand surface. The factors of efficient ventilation, use of chemicals, and appearance in closely settled communities were cited as contributing to making use of the glass-over beds worthy of consideration.

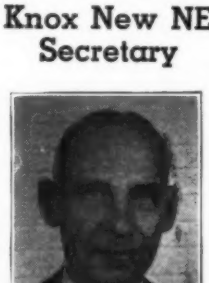
The use of alum to accelerate sludge drying is a method which evoked considerable discussion. Several speakers pointed out the importance of applying alum in such a way as to retain the carbon dioxide which is generated within the sludge in order to utilize its buoyant effect. It was reported that one plant is successfully adding ground garbage to raw sludge, dewatering on vacuum filters, and incinerating. The sludge cake so obtained has a volatile content of 75 per cent instead of the normal 50 per cent. While the cake is higher in moisture content, this is more than balanced by the higher calorific content which results from the addition of garbage.

Industrial Waste Ordinances

Much interest was expressed in the subject of industrial waste ordinances and sewer rental charges, but limited time was available at this last session. The method of charging for industrial wastes at New Brunswick, N. J., was described as satisfactory to industry and to the municipality. Since the plan was developed in 1944, it has gradually been made 100 per cent effective and now that new plant additions are required it is expected that about 80 per cent of the cost will be paid by industry. In Los Angeles, Calif., a committee has been functioning to enforce ordinances concerning industrial wastes. The additional sewage treatment required will cost about half a million dollars and will be paid for by industrial waste charges.

Buffalo, N. Y., is the first city to develop a formula for charging industry on the basis of analysis of the waste.

"Joe" Knox New NEWWA Secretary



The New England Water Works Association Executive Committee appointed Joseph C. Knox, Sr. Sanitary Engineer, Mass. Dept. of Public Health, Boston, Mass., as Secretary of the Association at its meeting in October. Mr. Knox succeeds Walter C. Conroy, General Supt., Belmont, Mass., who in turn succeeded to the secretaryship following the death of Frank J. Gifford in 1945. Mr. Conroy resigned because of press of other duties.

Joseph C. Knox has been a member of the Executive Committee of NEWWA and has been very active in the Association for many years. Also for more than 25 years he has been connected with the Mass. Dept. of Health and is now charged with special legislative investigations and studies of water supply needs and resources.

WOOL SCOURING WASTES TREATED BY NEW CHEMICAL PROCESS

Cooperation Between the Chemist, Manufacturer, and Engineer Provides a Modern Solution to an Old Problem

By HARRY A. FABER
Research Chemist
THE CHLORINE INSTITUTE, INC.
NEW YORK, N. Y.

and

PAUL F. HOWARD
Consulting Engineer
WHITMAN AND HOWARD, ENGINEERS
BOSTON, MASS.

WOOL scouring wastes are among the strongest wastes produced by the textile industry and, in addition, they constitute a distinct loss to the manufacturer. Several methods of treating these wastes are in use, but until recently no process has been satisfactory either for reducing the pollution load or for recovering the wool grease which they contain.

This report describes the development, after five years of research, of a new chemical process for treating wool scouring wastes. Through its use, the pollution load imposed on the receiving stream can be very materially reduced and a valuable by-product can be recovered. A full scale plant, specifically designed to employ the process, has been in successful operation for more than a year.

H. A. Faber

P. F. Howard

Characteristics of the Waste

The character of the liquor which results from scouring wool with alkali and soap approaches that of an emulsion in which the grease, organic matter, and fine solids remain in suspension. The waste is a brown, thickly turbid liquor, usually covered with a greasy scum and containing some settleable mineral solids. It is always alkaline and highly putrescible. In general practice, a part of the liquor is discharged continuously and the scouring train is completely emptied one or more times daily. The volume of wastes produced will be in proportion to the amount of wool scoured, but will vary with the type and efficiency of the scouring process employed. Each pound of scoured wool will usually produce from one to ten gallons of wool scouring waste.

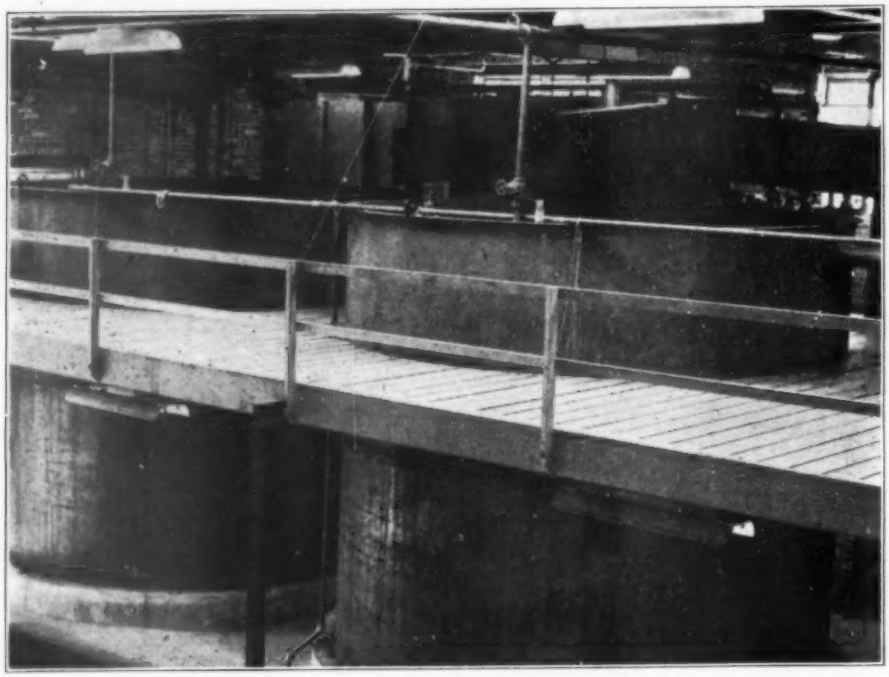
The examination of a large number of wool scouring wastes shows[1] these to average approximately 9,000 ppm. grease, 12,000 ppm. suspended solids, 7,000 ppm. alkalinity, and 5,500 ppm. B.O.D. During 1944 and 1945, analyses of wool scouring wastes from several New England woolen mills showed the 5 day B.O.D. value to range between 5,000 ppm. and 6,500 ppm.

Older Methods of Treatment

There is little published information concerning the full scale treatment of wool scouring wastes in the United States. The acid cracking process has been installed by a few wool combing mills in this country, and at least five of these installations are known to be in operation. It is reported that before 1925 two wool combing mills were scouring wool by a solvent extraction process and it is believed that the number of mills using this process has not increased since that time. More recently centrifugal processes have been developed for partially treating scouring wastes by recovering a high grade of wool grease. The number of wool combing mills which employ a centrifugal process is not known, but it is now in general use in many mills. Of many other methods proposed, none appears to have been placed in plant scale operation in the United States. Acid cracking treatment and centrifugal treatment are the only two processes of wool scouring waste treatment which can be considered to be in general use.

The acid cracking process has been employed by a few wool combing mills in the United States for many years. It is not only a highly odorous process, but the effluent produced is still unsatisfactory for discharge to

Wool Scouring Waste Treatment Plant of Abbot Worsted Co. at Forge Village, Mass.
Screen and pump house in right foreground.



Aeration and Hypochlorite Mixing Unit in Background, Two of Three Primary Settling Tanks in Foreground

streams. While much of the grease and suspended solids are removed by this treatment, the effluent is always acid and contains in solution much organic matter which becomes putrescible on neutralization. Experiments have shown that the acid cracked effluent can be further purified by chemical precipitation and by biological treatment, but both methods are expensive.

A number of wool combing mills in the United States have adopted the centrifugal process. It is employed as a method of grease recovery and is not intended as an effluent treatment process. Less than half of the grease content is recovered by this treatment and very little improvement is accomplished in the pollutional characteristics of the scouring liquor. The centrifuge effluent, like that from the acid cracking process, can be further purified either by chemical or biological treatment but, again, either method of treatment is expensive.

The Chlorine Process

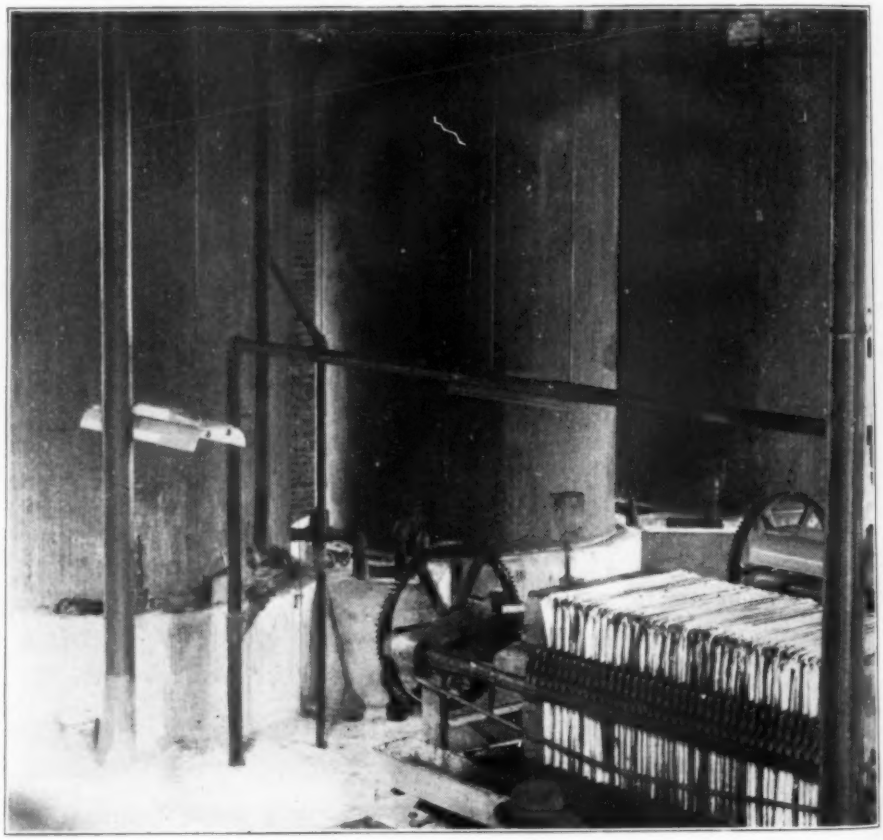
A process for the treatment of wool scouring wastes, which was based on an entirely different principle, was described,[2] patented[3] and used in Australia by Jean de Raeve. He was the first to point out that "The persistently emulsified condition of wool scour suds and their resolution results from the presence therein of gelatinous elements. . . . These products are protective colloids which entangle and hold the grease so that it resists separation."

Apparently the chlorine process of treating wool scouring wastes aroused no interest in the United States for twenty years. In 1936 Faber[4] studied the use of gaseous chlorine in conjunction with preaeration for increasing the removal of grease from sewage. His application was based on the principle advanced by de Raeve that chlorine would act to release grease by destroying the protective colloid effect of the proteins. This study and those of others are not directly comparable to the process intended for treatment of wool scouring wastes. The results, however, do show that the release of grease is increased by the action of chlorine and appear to substantiate the principle of the de Raeve process.

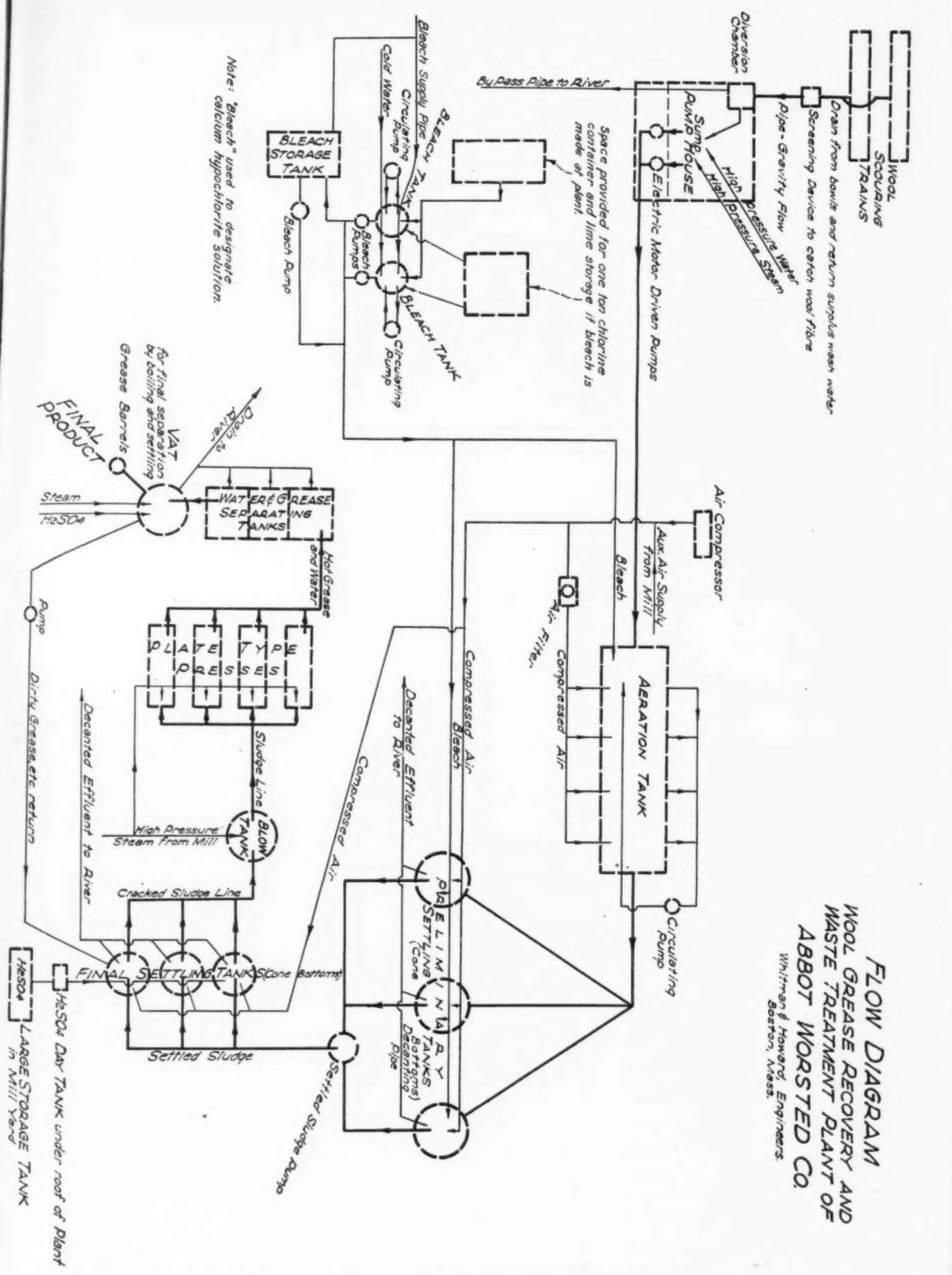
Pilot Studies Lead to Full Scale Plant

As stream pollution problems became more pressing, the need for an improved method of wood scouring waste treatment was recognized. During 1939, Fields Point Manufacturing Corp., Providence, R. I., undertook an investigation of the de Raeve process. Laboratory studies were first made of many samples of wool scouring wastes collected from wool scouring mills in New England. Pilot plant studies were then conducted at several mills, but the results obtained were far from uniform.

By 1943 it appeared that suitable control measures had been developed. In the summer of that year, further studies were made by Fields Point Manufacturing Corp. in a pilot plant erected for the purpose by Abbot Worsted Co. at its mill in Forge Village, Mass. During these studies it



Three Secondary Settling Tanks in Background, Filter Presses in Foreground



Flow Diagram—Wool Grease and Waste Treatment Plant—Abbot Worsted Co., Forge Village, Mass.

was discovered that the scouring waste from this mill could be treated with uniform success by applying chlorine as calcium hypochlorite solution instead of using gaseous chlorine. Based on this new procedure, that is, the substitution of an alkaline chlorine solution for an acid gas, the process was immediately simplified.

The results obtained in the pilot plant were reviewed by Fields Point Manufacturing Corp., Abbot Worsted Co., and by Whitman & Howard, consulting engineers for the Abbot Co. After careful consideration, Abbot Worsted Co. decided, upon recommendation of the engineers, to build a full scale treatment plant employing the hypochlorite process. Since the stream pollution problem at the Abbot mill was less serious than that existing at many other woolen mills, and since no precedent existed for the adoption of this process, the Abbot Company should be recognized as being unusually progressive in taking such action.

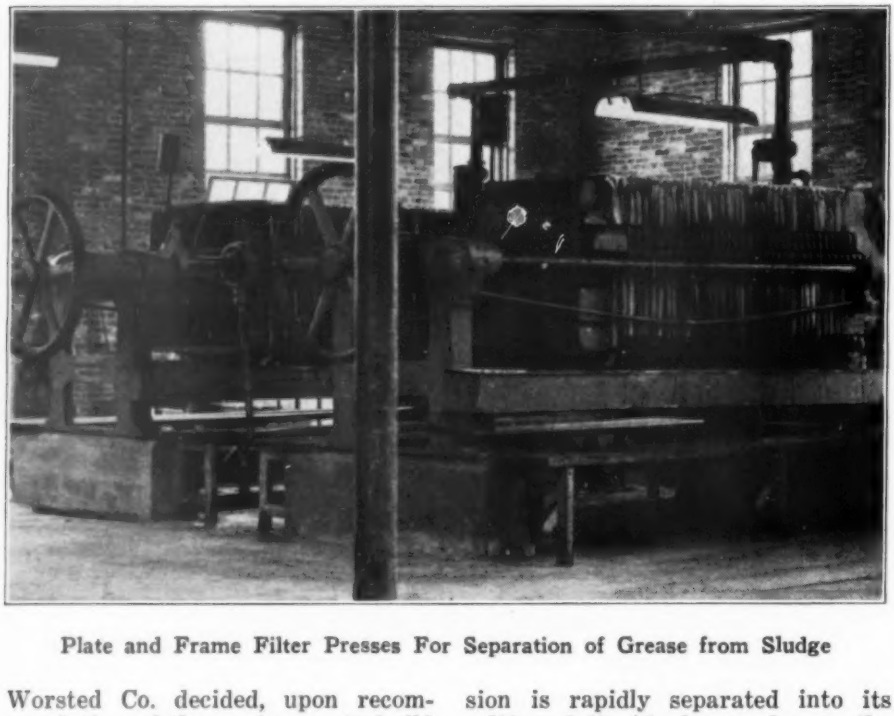


Plate and Frame Filter Presses For Separation of Grease from Sludge

The Hypochlorite Process

The hypochlorite treatment of wool scouring wastes was soon developed into a well controlled process which provides both an improved effluent and a high degree of grease recovery. In addition to the data obtained at the Abbot pilot plant, further studies have been made at other wool combing mills. It has been found that an existing acid cracking plant could be converted to use the hypochlorite process and the plant was so operated for several months. It has been found also that the scouring wastes from mills which employ centrifugal treatment for recovery of grease can be treated by the hypochlorite process. In fact, all types of wool scouring wastes studied to date have proven amenable to treatment by this process.

The first step in the process is the addition of calcium hypochlorite solution to the waste in a continuous flow mixing and aerating unit. Calcium hypochlorite reacts immediately with the sodium carbonate and soluble soaps, producing a precipitate of calcium carbonate and insoluble soaps. The wool scouring waste emulsion is rapidly separated into its solid and liquid phases, due to the oxidation of organic matter by the calcium hypochlorite.

The amount of calcium hypochlorite required for accomplishing precipitation and separation is readily determined by physical observation of the treated waste after a very brief reaction period. When the proper hypochlorite dose is applied, large curds of insoluble soaps will be formed. Different forms of calcium hypochlorite will vary in chlorine content, consequently the required dose can best be expressed in terms of chlorine. Based on performance in the Abbot mill, the amount of chlorine required for treatment will be approximately equal to the amount of alkali used in the scouring operation.

From the mixing and aerating unit, the treated waste is discharged to one of three primary settling tanks. The settling tanks are operated on a batch system and each tank provides eight hours' detention. After settling, the clear supernatant liquor is decanted and is discharged directly to the receiving stream or sewer.

The waste remaining after decanting consists of the sludge and scum layers which contain the grease and solids. This liquor is pumped to secondary settling tanks where sulfuric acid is added until the pH value is reduced to between 4.0 and 5.0. Mixing is provided by aeration. The acid releases chlorine from the hypochlorite and, after a detention period of eight hours, concentrated sludge liquor is produced. Supernatant from secondary settling is decanted and is discharged with the larger volume of primary supernatant.

Sludge from secondary treatment is discharged to a pressure tank, where it is heated with steam to a temperature of 190° F. Then steam or air pressure is used to force the heated sludge into plate-and-frame filter presses. Steam is applied to the presses until 70 to 75 per cent of the grease content of the sludge is removed. The filter cake which remains consists of approximately 15 per cent moisture, 15 per cent grease and 70 per cent of inert material. This filter cake can be disposed of on land where it dries readily and without nuisance.

The grease and water mixture flowing from the presses is discharged to a series of gravity separating tanks. The thickened grease is concentrated in a final tank, where it can be steamed and where it can be treated with mineral acid. The finished grease, light brown in color, contains about 2 per cent moisture and 8 to 15 per cent free fatty acid.

Design of Full Scale Plant for Abbot Worsted Company

Building of this waste treatment and grease recovery plant was undertaken primarily to eliminate the dumping of objectionable wool scouring waste into Stony Brook. It had been the practice for many years to discharge the wool scouring waste into lagoons. Much of the solid matter was deposited as the waste flowed through the lagoons and fifty to seventy-five thousand gallons of liquor per day with a B.O.D. of about 6,000 ppm. passed over the weir into Stony Brook. From time to time it became necessary to excavate the solid matter deposited in the lagoons and to dispose of it upon land. This practice resulted in complaints due to the objectionable odor in the vicinity, the disappearance of fish life and water fowl from the stream and the unsightly appearance of the stream and mill pond located about one mile below the Abbot plant.

In addition to constructing its treatment plant for the primary purpose of correcting objectionable conditions, Abbot Worsted Co. planned to recover wool grease. Those industrial wastes which can be treated so as to return a salable by-product are few indeed. Wool grease, however, is a valuable commercial material and the pilot plant studies had indicated the quality and quantity of this material which might be recovered in a full scale plant. On the basis of the pilot plant studies, it appeared that the income from the sale of grease would eventually pay the entire cost of treatment.

Basis of Design

The Fields Point Manufacturing Corp. had demonstrated the practicability of the process both by operating a small pilot plant and by temporarily converting an existing plant using the acid cracking process. The capacities, sizes, flow arrangement, type of materials and type of building construction were determined by Whitman & Howard, Engineers. In general, the design was based on their experience in treating other types of industrial waste and general sewage treatment practice. The sequence of operations is shown in the accompanying flow diagram. Small piping, auxiliaries, by-passes, etc., are not shown on the diagram.

The Collection of Scouring Liquor

Two scouring trains (each having four bowls) located in the basement of this mill are used to wash wool and mohair. The types of wool and mohair washed are varied at frequent intervals, and the characteristics of the waste liquor produced shows a corresponding variation. In general, the fine wools contain the most grease while the mohair contains less grease than any of the wools.

At present a system is employed of returning the wash water to the previous bowls. If desired, the rinse water of the final bowl may be run to waste without treatment. The dirty spent scouring liquor and sludge flows by gravity to a screening device located near the trains where wool fibre is recovered.

The waste liquor then flows by gravity to a concrete sump located under a brick building built for the purpose in the mill yard near the new treatment plant. The bottom of this sump is shaped like an inverted pyramid. The two pump suctions are located close to the apex. It is necessary at times, however, to agitate the solid matter which settles out of the liquor. Steam and water connections are provided for this purpose. The waste is pumped by means of open impeller type sewage pumps to a steel aeration tank located on the third floor of the treatment plant.

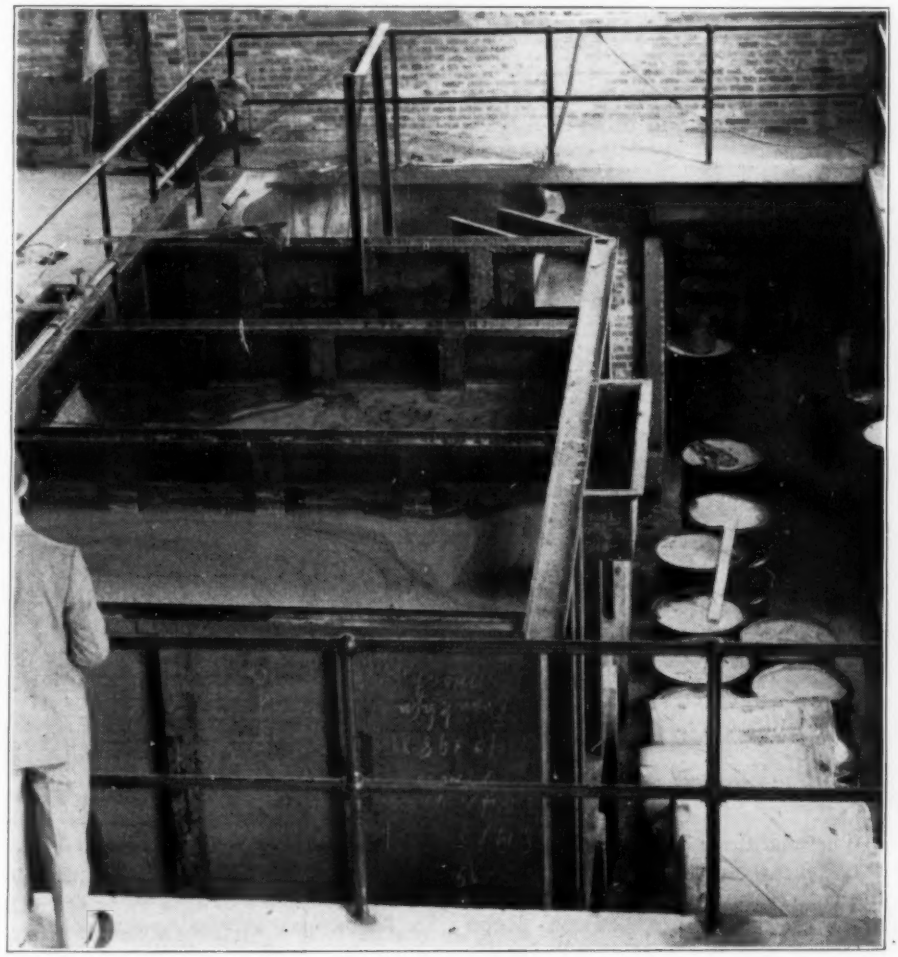
Aeration and Mixing Unit

Much thought was given to the design of an aeration tank in which the waste liquor could be detained for a considerable length of time, without permitting the solid matter to settle out, while air and calcium hypochlorite solution were added to it. This was accomplished by building a rectangular tank, the lower portion of which is divided into four sections each with an inverted pyramid type bottom. Liquor is drawn from the bottom of each section by means of a recirculating pump and thus is returned to the inlet end of the tank. Diffused air is applied by means of carborundum tubes located near the bottom of the tank. The arrangement of these tubes has been so successful that only one cleaning of the tubes has been required in fifteen months of operation. The calcium hypochlorite solution is pumped into the inlet end of the tank as required from the storage tanks which are later described. The aerated and chlorinated waste liquor flows by gravity from the aeration tank through steel troughs to the primary settling tanks.

Primary and Secondary Settling Units

The three primary settling tanks, each of 15,000 gallons capacity, are built of steel and have conical bottoms. Provisions were made in these settling tanks for adding additional calcium hypochlorite solution and for further aerating the liquor. After the solids have been precipitated and settled to the bottom, the supernatant liquor, exclusive of top layer of frothy scum, is drawn to waste by means of manually operating decanting pipes. This liquor is discharged without further treatment into Stony Brook. The settled sludge is pumped to the secondary settling tanks.

The three secondary settling tanks are also built of steel and have conical bottoms. Sulphuric acid is added to the sludge in these tanks, compressed

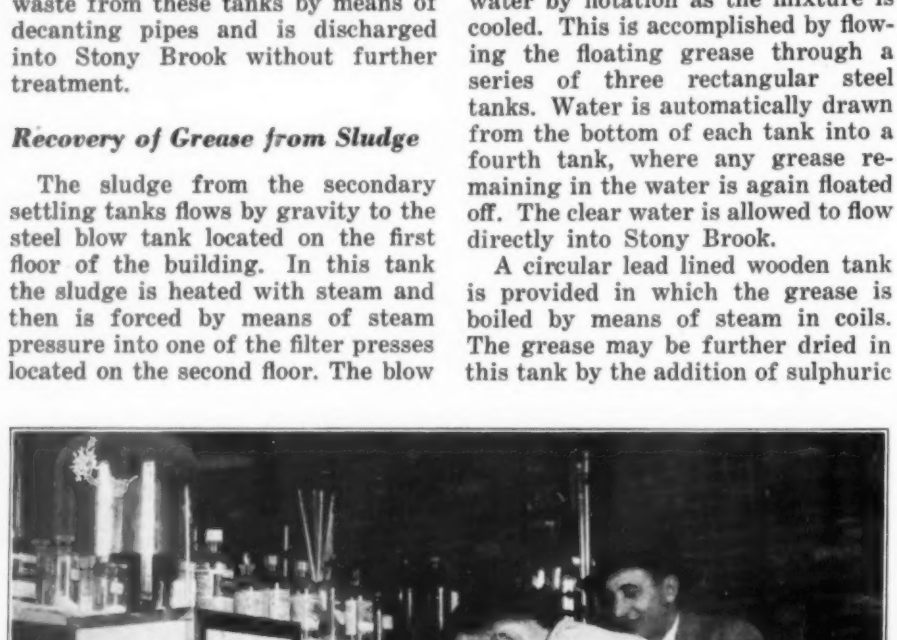


Grease Separating Tanks, with Drum Storage on Lower Level

air being used to mix the acid with the sludge. After secondary settling, supernatant liquor is also drawn to waste from these tanks by means of decanting pipes and is discharged into Stony Brook without further treatment.

Recovery of Grease from Sludge

The sludge from the secondary settling tanks flows by gravity to the steel blow tank located on the first floor of the building. In this tank the sludge is heated with steam and then is forced by means of steam pressure into one of the filter presses located on the second floor. The blow tank is heavily insulated to hold the heat.



View in the Plant Control Laboratory

The plant was operated for more than one year with two plate type filter presses, and recently a third press was placed in operation. Experience has shown that it will be better and less expensive to operate with four such presses and the fourth unit is now being added. These presses have iron plates and frames separated by filter paper supported on cloth. Steam pressure forces grease and water out of cocks at the base of the plates and the sludge (filter cake) is retained in the frames. The filter cake, manually removed at the end of the pressing operation, drops through openings in the floor under the presses directly into a truck trailer located in the basement. The odor of the filter cake is not objectionable. The cake has a very slight odor of chlorine and has the appearance of partially dried building plaster. Used for ground fill in public locations, the cake rapidly becomes dry and odorless. The grease and hot water flows by gravity in open steel troughs to the grease separation tank.

The grease separates from the water by flotation as the mixture is cooled. This is accomplished by flowing the floating grease through a series of three rectangular steel tanks. Water is automatically drawn from the bottom of each tank into a fourth tank, where any grease remaining in the water is again floated off. The clear water is allowed to flow directly into Stony Brook.

A circular lead lined wooden tank is provided in which the grease is boiled by means of steam in coils. The grease may be further dried in this tank by the addition of sulphuric acid. A return line with pump is installed to pump the grease back to the secondary settling tanks if for any reason further treatment should be desired.

The grease is discharged by gravity from the grease boiling tank into steel drums or barrels for shipment. Each filled drum weighs about 450 pounds. The full drums are wheeled to platform scales for weighing and then are stored in a room provided for the purpose. The building floor is at such a grade that the drums may be wheeled into a delivery truck without lifting.

Calcium Hypochlorite Solution

One large and two small concrete tanks are provided in the treatment plant. The large tank is designed for the storage of calcium hypochlorite and the smaller tanks may be used either for additional storage or for the manufacture of this material. Calcium hypochlorite solution is delivered to the plant in tank trucks and is pumped from storage to the aeration and mixing unit or to the primary settling units. All pumps used for handling this solution are electric motor driven, iron construction, centrifugal pumps. Should it prove desirable to manufacture calcium hypochlorite solution at the plant, space has been provided for the storage of one ton containers of liquid chlorine and lime in bulk. Recirculating pumps are installed for use in the preparation of calcium hypochlorite solution.

Construction Features

Compressed air and steam at both high and low pressures are furnished to the treatment plant from the nearby mill. Additional compressed air is furnished by an electric motor driven air compressor installed on the first floor of the treatment plant.

All piping is of steel. Certain pipe lines subject to corrosion are cement lined and joined together with special lead lined fittings. All valves in lines carrying waste liquor and sludge are of the lubricated plug type. Other smaller valves on bleach lines are all iron, outside screw and yoke clamp valves with wedge disc. Operation of the pump which delivers raw wool scouring waste to the aeration and mixing unit is controlled by float levels, and the same control mechanism can be connected to regulate the addition of calcium hypochlorite solution and of diffused air to the same unit.

The waste treatment and grease recovery building has concrete foundations, brick walls and a flat wooden roof supported on steel beams. The floors of the building are of concrete. The main part of the building is three stories high, 75 feet long by 60 feet wide. A one story grease storage room is attached at the rear and a one and two story projection at the front houses the bleach making facilities, control laboratory, toilets, lockers, etc.

Operating Data

The plant is operated in two shifts and requires the services of a total of four to five men. The largest single item in the cost of operation is for calcium hypochlorite solution; other costs are for filter cloths, acid, steam, electricity, and general maintenance. Records of plant costs and of return from the sale of grease have been carefully maintained. Numerous improvements have been made and, as the treatment process has become better understood, it is now possible to report that, based on the present price of grease, the income from the sale of grease exceeds the cost of operation. As final op-

erating cost and revenue figures cannot yet be determined, specific figures have been omitted until more data is available.

Recovery of Wool Grease

Using the hypochlorite process, about 98 per cent of the grease can be removed from the scouring wastes and from 70 to 75 per cent of the grease can be recovered and sold. At present prices, this type of wool grease sells at eleven cents per pound. If the mill scoured only the grades of wool high in grease, the process could be very profitable, indeed. Unfortunately, the chemical dosage is largely determined by the chlorine demand of the scouring waste and not by its grease content. Thus, the chemical requirements for treatment of a scouring waste low in grease are at least as high as the requirements for a waste high in grease, making the chemical costs and operating costs proportionately higher for grease recovered from scouring wastes low in grease.

In a plant built to employ the hypochlorite process, the fixed charges of interest, depreciation, power and labor will be independent of the type of wool scoured. The chemical costs per pound of grease recovered will be proportionately higher for wastes low in grease than for those high in grease. The percentage recovery of grease will be lower from wastes low in grease.

Stream Pollution Aspects

The full scale plant has operated consistently without odors, producing a clear effluent slightly yellow in color and slightly alkaline in reaction. Settleable and suspended solids are completely removed from the wastes, and less than 5 per cent of the grease content remains in the effluent. The removal of B.O.D. varies from 80 to 90 per cent.

Some discussion of the B.O.D. value of these wastes is warranted, however, because the percentage removal figure may be misleading. In general, the B.O.D. of the raw wool scouring wastes is extremely high, ranging from 5,000 ppm. to 6,500 ppm., and the B.O.D. of the treated effluent is about 600 ppm. to 700 ppm. It must be taken into consideration that the determination of the B.O.D. of a chlorinated effluent is not an entirely satisfactory procedure. The effluent from the hypochlorite process contains a substantial amount of residual chlorine, generally from 25 to 50 ppm. Samples of such effluent must be dechlorinated in order to determine the B.O.D. value, and the results of this determination are not strictly comparable with the demand which a chlorinated effluent actually exerts on the receiving stream.

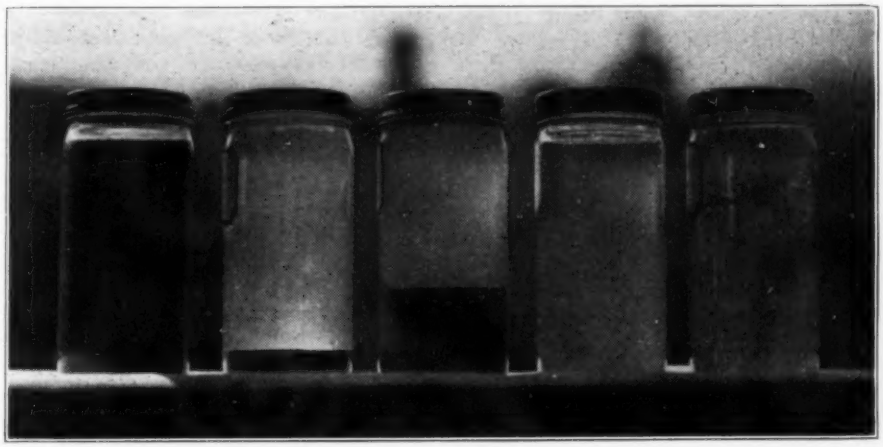
The effect of such treatment has been immediately apparent in the improved appearance of the stream into which the treated effluent is discharged. The present effluent no longer contributes sludge deposits, decomposing solids, grease, or excessive oxygen demand. Fish and other aquatic life have returned to the stream not far below the point at which the effluent enters.

Patent Application Made

Fields Point Manufacturing Corp., which developed the hypochlorite process for the treatment of wool scouring wastes and for the recovery of wool grease, has made a patent application to cover its use. Rights to use the process are available to woolen mills where such treatment is applicable.

Acknowledgment

The authors wish to express their appreciation for the information supplied by Messrs. Edward Abbot, President, and A. A. Cameron, Manager, Forge Village Plant of Abbot Worsted Company, and by Messrs. Daniel Townend, President, and Joseph Campanella, Chemical Engineer, of Fields Point Manufacturing Corp.



Samples of Wool Scouring Waste Showing Progressive Improvement in Quality
From left to right: (1) *Raw waste before treatment;* (2) *primary waste after treatment with calcium hypochlorite;* (3) *secondary waste after treatment with acid;* (4) *effluent from acid treatment;* (5) *effluent from hypochlorite treatment.*

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2. de Raeve, Jean. Clarification of Wool Scourers' Effluent and Recovery of Wool Fats. *Ind. and Eng. Chem.,* Vol. 17, p. 837, 1925.

3. de Raeve, A. J. Treating Trade Waste Waters to Clarify and Sterilize the Same and to Extract Fats Therefrom. U.S.P., 1,543,324, June 23, 1925.

4. Faber, H. A. Chlorinated Air Proves an Aid in Grease Removal. *Water Works and Sewerage,* Vol. 84, p. 171, 1937.

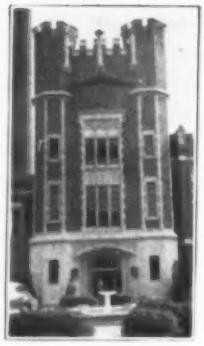
New Water Supply for Guayaquil

The City of Guayaquil, Ecuador, has contracted with three United States firms for investigations, design, construction and initial supervision of operation for a new waterworks system to serve the city.

Buck, Seifert and Jost, Consulting Engineers of New York City, are making a study of the water supply requirements and proposed sources of supply and, after completion of their report, will prepare construction plans and specifications and supervise construction. The Frederick Snare Corporation of New York City will perform the construction work. After completion, operation of the waterworks system will be supervised for one year by the Pitometer Company of New York City.

The new system is expected to consist of intake works on the Daule River about thirty kilometers north of Guayaquil and an aqueduct leading to the city, together with large sedimentation basins to partially clarify the silt-laden river water, diesel-electric pumping station, filtration plant, distribution reservoirs and transmission and distribution system improvements. The cost of the project will be about $4,000,000. It is to be financed by the Export-Import Bank.

The present inadequate 5.8 mgd. water supply of Guayaquil, a city of about 170,000, is obtained from mountain streams in the foothills of the Andes, 90 kilometers east.



ENTRANCE TO KNOXVILLE FILTRATION PLANT AND PUMPING STATION.

KY.-TENN. SECTION MEETS IN KNOXVILLE

Features Stream Pollution and Sires New Ky.-Tenn. Sewage Works Association

Chairmen

(Retiring)
John J. Quinn
Chemist
Water Bureau
Knoxville, Tenn.

(Incoming)
Byron E. Payne
Asst. Supt.
Water Works
Louisville, Ky.

RESUMING its annual meetings after a wartime cessation, the Kentucky-Tennessee Section of AWWA held its first post-war meeting in Knoxville, Tenn., Oct. 28-30. The attendance approximated 150.

Topics featured on the program were Stream Pollution Control, Public Relations, Taste and Odor Control Through Chlorine Dioxide Treatment and Breakpoint Chlorination. A highly popular session was that featuring a Panel Discussion of Water Supply Problems and their solution. The closing session was given over to Stream Pollution and its effects on public water supplies. At the close of this session the Section stood Godfather at the birth of the new Ky.-Tenn. Sewage Works Association, after hearing the Vice-President of the Sewage Works Federation, George Russell of St. Louis, and W. H. Wisely, Exec. Secy. of the Federation, review the aims, objectives and accomplishments of the Federation. The Ky.-Tenn. Sewage Works Association will function under the guidance of the Secretary of the Ky.-Tenn. Section of A. W. W. A., R. P. Farrell, who was also elected Secretary of the Sewage Works Ass'n. The meetings of the Association will be held jointly with those of the AWWA Section.

A Stream Pollution Resolution

At the close of the session on Stream Pollution the following resolution was introduced by **Henry M. Gerber,** President of the municipally owned Louisville, Ky., Water Co., and was approved unanimously after some discussion, which indicated no desire on the part of members of the Section to jeopardize the status of the State authorities in advocating Federal pollution legislation. The resolution reads:

"Whereas, the Kentucky-Tennessee Section of the American Water Works Association views with alarm the continued and increasing pollution of our streams with little satisfactory regulatory legislation.

"Now therefore be it resolved that the Kentucky-Tennessee Section of the American Water Works Association petitions the national officers and directors of the American Water Works Association to review, support and promote and, if necessary to initiate such national legislation as will, with the least delay, clean up the streams of the nation and prevent or mitigate further pollution or to vigorously support any legislation pending before the Congress that will achieve this end, with all the power and resources at its command."

Mr. Gerber, explaining the underlying reason for his resolution, pointed to the proven difficulty of obtaining adequate cooperation of individual States in securing pollution abatement on interstate streams. In particular, he cited the failure of the proposed Ohio Valley Compact, because all States concerned could not reach an agreement. Because this important test of State cooperation had proved a failure after several years of effort, and accomplished so little in reducing pollution which had worked such a hardship on Ohio River water treatment plants, he saw faint hope of securing permanent relief on such vast drainage areas without Federal legislation in some form or another.

"Trusteed"
Lois Sutherland
Supt. & Treas.
Paducah Wtr. Wks.
Paducah, Ky.
(Elected Section Trustee—Her Public Relations Problems Few)

Secy.-Treas.
R. Paul Farrell
Chief Engr.
State Hlth. Dept.
Nashville, Tenn.

Vice-Chmn.
G. R. Kavanagh
Distr. Mgr.
W. & T. Co.
Knoxville, Tenn.

Water and Sewage Works Associations' Big Guns
Harry E. Jordan, Exec. Secy., and Wendell R. La Due (No. 3), President of A.W.W.A., from Akron, Ohio.

George Russell (No. 2), Vice-President of the Federation of Sewage Works Assns., from St. Louis, and Homer Wisely, Exec. Secy., were on hand for the launching of the Ky.-Tenn. Sewage Works Association.

Stream Pollution Control in Tennessee and Kentucky

In reviewing "Progress in Stream Pollution Control in Tennessee,"

AWWA Directors

Clark J. Cramer
Chief. Engr.
Lexington Water Co.
Lexington, Ky.
(Incumbent)

Chas. M. McCord
Supt. & Engr.
Water. Dept.
Memphis, Tenn.
(Director-Elect.)

R. P. Farrell, State Sanitary Engineer for Tennessee, stated that in 1945 the State Legislature had established a Stream Pollution Control Board, the chairman of the Board being the Health Commissioner of Tenn., and the secretary of the Board being the Chief State Sanitary Engineer. While the Act creating the Pollution Control Board gives it broad powers, Mr. Farrell pointed out the requirement that before action can be taken against polluters it is necessary to develop stream standards as guides in establishing requirements of polluters to cover various situations.

The plan now initiated is that of making stream studies on a river basin basis. At present the force assigned to these studies consists of a principal sanitary engineer, chemist, stenographer, and a consulting engineer retained on a part time basis. In time this "experimental staff" will be amplified or duplicated for the study of additional streams as separate units. Two laboratory trucks have been purchased from Army surplus and a station wagon has been equipped for limited analytical work at checking points and for fluid spot work in the field. Considerable work is also done in the central laboratory of the Tenn. Dept. of Health. In addition, a goodly amount of cooperation and assistance has been rendered in the studies by the Tenn. Valley Authority.

Mr. Farrell stated that the Act of 1945 made it mandatory for polluters to file applications prior to July 1, 1946, for permits to continue existing pollution and for any additional pollution contemplated. So far 352 applications have been filed but only 25 permits have been issued. Amongst the Tenn. municipalities 41 have taken action to abate pollution and a number of industries have inaugurated studies or have engaged engineers to make studies and prepare plans for waste treatment plants.

Mr. Farrell was particularly appreciative of the assistance and cooperation from the T. V. A. in the matter of making stream studies and supplying valuable data to supplement that of the Tenn. Dept. of Health used in legislative hearings on the Pollution Act of 1945. It is the plan of the Pollution Control Board to provide copies of its proposed minimum criteria of water condition in streams to Federal agencies for review before final adoption. On the Technical Committee of the Board industry has two representatives, the T. V. A. one, the Depts. of Agriculture and Conservation one each. The Board itself consists of two industrialists, two representatives of municipalities, the Commissioners of Agriculture and Conservation and the Commissioner of Health as Chairman.

"Stream Pollution Control in Kentucky" was discussed by **Robert R. Harris,** Prin. Asst. Sanitary Engr., Ky. State Dept. of Health, who reported the most serious pollution of Kentucky streams to be distilling wastes, phenolic wastes and acid mine drainage. However, Kentucky could report only inadequately organized progress in the abatement or control of such pollution. The Ohio River Sanitary Board, through cooperative efforts on the part of the several State Sanitary Engineers, had been successful in reducing phenolic waste pollution by about 90 per cent. The Federal Government had installed evaporators and dryers in distilleries making alcohol for the Government, the result being valu-

New Sewage Ass'n Officers

Clark Dugan
Chief Engr.
State Hlth. Dept.
Louisville, Ky.
(President)

James Ellis
Gen'l Supt.
Tenn.-Eastman
Kingsport, Tenn.
(Nat'l Director)

able feed for stock and a 9 million population equivalent in the form of distilling wastes reduced to about 4 million. Mr. Harris reported that Louisville has earmarked about $7,000,000 to spend on improvements to the sewer system and for providing sewage treatment. Kentucky has only 85 municipal sewage treatment plants. The State is in the process of dividing Kentucky into four major Sanitary Districts, one of which has already been organized and a second is under way.

Stream Pollution as Related To Water Supply

In a Panel Discussion this topic was covered by S. Leroy Jones, Tenn. Dept. of Health; F. W. Kittrell, T. V. A. Engineer; W. J. Eldridge, Water Purif. Engr., Du Pont Co., Old Hickory, Tenn.; John J. Quinn, Supt. of Purification, Knoxville, Tenn., and Mr. Churchill, T. V. A. Engineer.

Mr. Kittrell pointed to the evidence of increased cost of water purification with increasing coli content and concurrent increase in B.O.D. He also emphasized the cost to good public relations suffered by water utilities as the result of taste and odors of the water for which industrial pollution is responsible, in

Fred A. Eidsness
"Infilco"
Atlanta, Ga.
and
Louis J. Figg
Tenn.-Eastman Corp.
Kingsport, Tenn.

"Doug" Smith
Calgon, Inc.
Greenville, S. C.
and
"Dick" Gibson
"J-M"
Atlanta, Ga.

A. R. Murphy
Div. Mgr.
W. & T. Co.
and
W. R. La Due
Supt. W. & S.
Akron, Ohio

Bill Lovejoy
Supt. of Filtration
Louisville, Ky.
and
B. E. Payne
Asst. Supt. of Water
Louisville, Ky.

Julian Fleming
Asst. Prof. San. Eng.
and
Cec l S. Camp
Asso. Prof. San. Eng.
Univ. of Tenn.
Knoxville

addition to markedly increased cost of effectively treating such waters.

Mr. Eldridge, in analyzing the basic considerations in pollution abatement, felt that up to a reasonable point, even at increased water purification costs, the economics of the matter would dictate that the least costly procedure would be that of spending more for water treatment rather than proceed to more refined treatment of the wastes at enormous costs. He advocated recovery of products and materials from plant wastes as the first step toward pollution abatement and treatment of only the residual waste to the degree demanded for the specific condition. This he termed "Cooperative Economy" in the highest use of available facilities and attainment of objectives on a practical basis. To this end it would be necessary for all interests to cooperate in reaching a general plan to be applied in each individual situation or each stream zone, with a complete understanding between all concerned. To ignore such a procedure would be to incur the hazard of wasting money on a gigantic scale.

Mr. Quinn cited the value of the lakes created by the T. V. A. above Knoxville in regards to their minimizing the effects of industrial wastes at the Knoxville purification plant. The relatively uniform quality of raw water had made life much easier for the plant supervisor and operators, and overall treatment costs had been lessened also.

Mr. Churchill told of the marked effects of temperature in creating a baffling problem at Harriman, Tenn., whereby warm mill wastes had floated on the cooler water of the area of lake and short circuited to the water plant intake during winter. The solution of the problem was that of discharging the warm wastes through a deep outlet in winter and through a shallow outlet in summer. Unfortunately, this same solution could not be applied to the municipal sewage situation and Harriman continued to drink its own sewage in part.

Employee Training and Public Relations

"Employee Training" as it is practiced by the Am. Water Works and

Hosts
M. B. Whitaker, Gen. Supt.
C. H. Bagwell, Supt. of Meters
J. J. Quinn, Supt. of Filtration
Bureau of Water, Knoxville

Electric Co. was highlighted by **E. E. Jacobson**, Manager, Lexington, Ky., Water Co., who stressed the importance of using great care in the selection of new employees. The practice of his company involves use of a questionnaire and careful checking with the former employers of the applicant. Sound pictures, known as "Vocafilm," are used to educate the new employee in conduct becoming to all who must deal with customers. Monthly "Safety Meetings" are held for employees at which public relations are emphasized and company policy is discussed and analyzed for the benefit of the employee.

Believing that misinformation given by employees is much worse than none at all, the management gives special training to specific employees who are designated to answer specific types of questions or complaints of customers. The customer is, therefore, turned over to the employee most effectively prepared to answer any given question or complaint. This is believed to be highly important. Another policy is that of assuming that "the customer is NOT always right," but does deserve proper and courteous explanations and argument. Therefore, the employee must have accurate information under these circumstances. Wherever possible telephone explanations are avoided in preference to personal contact with the complaining customer. Mr. Jacobson revealed that his company has a system of annual evaluation of employees in an effort to maintain operating efficiency and public relations on a high plane. Amongst the rules of the company which the employee is expected to follow at all times are the following:

1. Treat customers as you would expect to be treated.
2. Be pleasant and smile often.
3. Don't hesitate to admit errors —errors are human.
4. Never bluff answers to questions.
5. Never promise anything without certainty that it can or will be done.
6. Treat the little customer just as you would a large one.
7. In short, tell the truth and make friends at every opportunity; if you can't, you don't belong in a public utility business.

After his discourse Mr. Jacobson showed a motion picture used by the 80 odd companies in the Am. Water Works and Electric chain to impress on employees the difference between good and poor public relations as the result of employee conduct.

Public Relations Panel

Following Mr. Jacobson's presentation a Panel on Public Relations was conducted with Henry M. Gerber as chairman, C. M. McCord of Memphis, Tenn., R. P. Coldiron of Danville, Ky., and Max Bartlett of Knoxville participating.

Mr. Gerber stated that the Louisville money saving change to bimonthly billing was pleasing to the public. The water utility pays one-half of the cost of group insurance carried by employes and pays all health insurance. Publicity is given to the fact that the Louisville Water Co. (municipally owned) is self supporting and not supported in any manner from tax funds.

Mr. Bartlett, manager of the Knoxville Water and Power Commission, believes in neatly uniformed meter readers and in dressing up the utility properties in an effort to develop a community pride in the Knoxville water supply. On the filtration plant property picnic grounds have been

"Gene" Hargett
Ford Meter Box Co.
Bowling Green, Ky.
and
L. S. Vance
Supt. & Chief Engr.
Louisville Wtr. Wks.

F. S. Key
Water Works Engr.
Kingsport, Tenn.
and
M. L. West
Supt. of Filtration
Kingsport, Tenn.

Geo. Russell, V.-P., and "Pete" Wisely, Exec. Secy. of the Sewage Works Federation with a group planning the Ky.-Tenn. Sewage Wks. Association

J. J. Guthrie
Supt. of Water
Signal Mtn., Tenn.
and
O. R. Burell
Engr. of Distribution
Chattanooga, Tenn.

Tom McCreery
U. S. Pipe & Fdy. Co.
Birmingham, Ala.
and
"Jim" McCoy
Supt. of Filtration
Madisonville, Ky.

established and attractively maintained as one means of attracting attention to the efficiently operated and maintained plant.

Mr. McCord stated that in Memphis they had made no special efforts to popularize the water utility but had conducted its business on the basis of being reasonable and fair to all alike while trying to do an adequate job. He felt that in this direction the value of well prepared and thoroughly enforced rules and regulations could not be over-emphasized in providing equitable treatment for the large and small interests alike. As to the press, it had been his experience that any utility would profit by providing "reporter training." By this he meant that newspaper reporters with little understanding of a water supply system and water works problems can well produce cockeyed and misleading stories, whereas some reporter training would tend to correct this deficiency which makes water works managers fear the results of press reporting.

Programmers

E. E. Jacobson
Manager
Lex. Water Co.
Lexington, Ky.

R. R. Harris
Asst. Engr.
State Hltn. Dept.
Louisville, Ky.

Panel on General Water Works Problems

A panel discussion intended to cover water works problems in general was held under chairmanship of Wm. H. Lovejoy, Supt. of Filtration at Louisville, Ky. On the panel were Byron Payne, Asst. Chief Engr. and Supt., Louisville, Ky.; Clark J. Cramer, Chief Engr., Lexington Water Co., and Robert R. Harris, Asst. Engr., Kentucky Dept. of Health.

Mr. Lovejoy opened the discussion by stating the observation that stream flows have been reaching new minimums during the past fifteen years while pollution had been increasing. The result is that the production of a safe and palatable water from purification plants has become increasingly difficult. So much of a problem has this become at Louisville that the city is financing a study by the U. S. Geological Survey of ground water potentialities for Louisville. The Geol. Survey is matching Louisville's contribution of $10,000 toward the cost of making the study of the possibility of constructing large wells or infiltration galleries along the river above Louisville and thereafter utilizing as little of the river supply as possible.

Mr. Payne revealed that the survey indicates a good water bearing strata near the present pumping station of Louisville. The water apparently enters from the Ohio River above the city. The depth of sand and gravel is 100 ft. and the test wells indicate no contamination in the naturally filtered water. Mr. Payne explained that any municipality can procure the same cooperation and matching of funds by application to the U. S. G. S. one year in advance of the making of the survey, this being because of the budgetary requirements of the Survey.

Panel Chairmen

Henry M. Gerber
President
Munic. Water Co.
Louisville, Ky.

Wm. H. Lovejoy
Supt. Filtration
Munic. Water Co.
Louisville, Ky.

Mr. Payne then described the flood proofing of the Louisville Pumping Station as the result of the 1937 flood of floods. The station now has installed two 30 mgd. vertical shaft pumps with motors located 10 ft. above the all-time high 1937 flood elevation. The station is supplied through two electrical transmission lines. While the regular pumping is done by steam power, the increasing cost of labor is making cost of electrical pumping less unfavorable.

Mr. Cramer told of the deficiency of the lake supplies of Lexington, necessitating augmentation by pumping from the distant Kentucky River whenever the lake storage drops 40 per cent.

Mr. Lovejoy, in discussing improvements in water treatment at Louisville, revealed that the best solution to their problem of coping with increasing pollution had been super-chlorination applied to the raw water. He could not find a breakpoint on the Louisville water but found a chlorine dosage of 50 lbs. per million (6 ppm.) gave the desired results in the form of a more palatable water, no bacterial aftergrowths, improved coagulation, cleaner filter beds and longer runs. As the control test, Louisville uses the bacterial aftergrowth test in addition to the residual test. The break-point is too difficult to locate. The super-chlorination effects are best at a pH of 7 or under. It is expected that even higher dosages than the 6 ppm. will be used at times and Louisville is increasing its chlorination facilities accordingly, switching to the use of single unit tank cars of chlorine as preferable to the handling of one ton containers.

Mr. Harris spoke on the problem of controlling lime application at small filter plants where a slight overdosage of lime destroyed the alum floc. He asked if there was any remedy or what should be done to avoid this difficulty, and L. H. Enslow offered the suggestion that precipitated chalk or very fine marble or limestone dust be used instead of hydrated lime. While the chalk would be more expensive, this was not so important in small plant operation and a slight over-dosage would not peptize the alum floc. The scheme had worked very satisfactorily wherever tried and particularly where color removal from very soft waters was the problem.

Chlorine Dioxide and Breakpoint Chlorination

"The Use of Chlorine Dioxide in Water Treatment" was discussed by **Roy N. Aston**, Technical Representative, Mathieson Alkali Works, Niagara Falls, N. Y., who presented a paper scheduled to be given by J. D. MacMahon of the same company.

Mr. Aston explained the effectiveness of the chlorine dioxide treatment as strictly that of oxidation and destruction of taste producing compounds. Always used in conjunction with chlorination, it can be ap-

Programmers

W. J. Eldridge
Supervisor
Water Treatment
Du Pont
Old Hickory, Tenn.

F. W. Kittrell
Act'g Chief
Stream Studies
T. V. A.
Knoxville

plied prior to, simultaneous with or after the chlorine addition. The most economical point of application is after chlorination and filtration. The most effective results have been ob-

W. H. Johnson, Supt. of Water, Harrodsburg, Ky.

J. Sanders Parker, Cons. Engineer, Nashville, Tenn.

Julian Fleming, Asst. Prof. San. Eng. Univ. of Tenn., Knoxville

tained when prechlorination of the raw or pre-filtered water is practiced.

In the larger plants chlorine dioxide is made by merging together the solution of sodium chlorite and the discharge from a solution feed chlorinator and providing a brief contact period enroute to the point of application. In the smaller plants a solution of high test hypochlorite, a dilute sulphuric acid solution and the solution of sodium chlorite are merged in the contact chamber. The dosage of chlorite and acid are usually set at a fixed rate while the hypochlorite feed is varied to meet changing chlorine demands.

Mr. Aston cited a number of case records of effective chlorine dioxide treatment which involved chlorine dioxide dosages of 0.5 to 1.0 ppm. expressed in terms of available chlorine. This is equivalent to between 2.5 and 5 lbs. of sodium chlorite per million gallons. One of the advantages from chlorine dioxide treatment is that it is far easier to maintain a chlorine residual in the distribution system, since the dioxide destroys the slow chlorine demanding organic material through rapid oxidation.

"Breakpoint Chlorination Progress" was discussed by **Noel S. Chamberlain,** Development Chemist, Wallace & Tiernan Co., Newark, N. J.

Mr. Chamberlain described what has been commonly termed "breakpoint chlorination" as the degree of chlorination which produces a residual of true available chlorine in the form of hypochlorous acid (HOCl) to the extent of 1 ppm. or more of residual *free* chlorine. This he contrasted with ordinary chlorination which produces a residual which may in part or wholly be combined with organic compounds or ammonia compounds. Thus he defined breakpoint chlorination as "Free Residual Chlorination" and ordinary chlorination as "Combined Residual Chlorination," these terms being more descriptive than any other.

In determining whether one has free residual chlorination or combined residual chlorination, the ortho-tolidin test will reveal it simply. Only that residual which develops color immediately (1 minute or less) is "free residual." Color which develops after 1 minute of contact is "combined residual." When free residual chlorination is in effect, the total residual chlorine will consist of not less than 85 per cent free residual indicated by color developed immediately and not more than 15 per cent developed after the first minute of contact in the standard ortho-tolidin test.

Mr. Chamberlain pointed out that in free residual chlorination ammonia is destroyed. Thus there is removed an important food for organisms within pipe systems and a nutrient to slime growths, algae, etc. The effect is the suppression of aftergrowths in distribution systems, cleaner, smoother pipe line interiors, cleaner filter beds, improved coagulation and manganese removal, complete algae and bacteria destruction as well as taste and odor destruction. In maintaining sterile mains, corrosion due to anaerobic decomposition in dead ends, hydrant stubs, etc., is checked and fresh water remains fresh.

Entertainment

On the first evening a social hour with a movie and entertainment was provided. On the second evening the annual dinner was followed by a dance. W. R. LaDue, President of AWWA, was the dinner speaker. With his interesting presentation of some startling statistics revealing the relative importance of the water supply industry amongst America's largest industries, and his comments on the importance of good public relations to the publicly owned as well as the privately owned water utilities, he found a most attentive and interested audience.

On the closing day a complimentary luncheon was served at the Knoxville Filter Plant by the Knoxville Utilities Board. The guests had an opportunity of looking over a spic and span plant surrounded by well kept and attractive grounds.

Officers Elected

The following officers were declared elected by letter ballot prior to the meeting.

Chairman—Byron E. Payne, Asst. Chief Engr., Louisville, Ky., Municipal Water Co.

Vice-Chairman—Gerald R. Kavanagh, Distr. Mgr., W. & T. Co., Knoxville, Tenn.

Secy.-Treas.—R. Paul Farrell, Chief Engr., State Health Dept., Nashville, Tenn.

Trustees—Miss Lois Sutherland, Treas. & Supt., Paducah, Ky., Water Works; Robt. W. Williamson, Treas. & Mgr., Columbia, Tenn., Water Works.

AWWA Director†—C. M. McCord, Director, Division of Water, Memphis, Tenn.

Sewage Works Ass'n Officers

The following were elected officers of the newly formed Ky.-Tenn. Sewage Works Assn.:

President—Clark F. Dugan, Chief Engr., State Dept. of Health, Louisville, Ky.

Vice-Pres.—Julian Fleming, Asst. Prof., San. Eng., Univ. of Tenn., Knoxville.

Secy.-Treas.—R. Paul Farrell, Chief Engr., State Dept. of Health, Nashville, Tenn.

*Director**—James Ellis, Genl. Supt., Tenn.-Eastman Corp., Kingsport, Tenn.

With Regrets

Because of delayed arrival at the meeting we were unable to hear and report a discussion covering "Radio Communication" by C. E. Eubanks of the Knoxville Bureau of Water, and a talk by H. E. Jordan on "Some of the Basic Policies of the Am. Water Works Assn."

(†The new Director succeeds J. Clark Cramer as AWWA Director at the close of the 1947 Convention in San Francisco.)

*Representative on the Board of Control, Federation of Sewage Works Assns.

F. W. Kittrell
Chief of Stream Studies
Robt. N. Clark
Chief San. Engr.
O. W. Kochtitzky
San. Engr., T.V.A.

M. B. Whitaker
Genl. Supt., Water Bureau
Max C. Bartlett
Gen. Mgr., Utilities Board
Larry Dukes
Supt. of Maint., Knoxville

R. J. Bartlett
Supt. of Distrib.
(Mrs. Bartlett)
and Earl T. Mitchell
Supt. of Filtration
Paducah, Ky.

IMPROVING WATER PLANT OPERATION WITH ACTIVATED SILICA

Part III*—Low Temperature Coagulation

By HAROLD R. HAY
Chemical Department
PHILADELPHIA QUARTZ CO.

The Author

A WATER supply "just warm enough to flow" would please some consumers, but very few water plant operators. Those operators treating water would prefer it "warm enough to floc." Various devices and practices have been tried to overcome coagulation difficulties in the winter months. Frequently, several remedial measures must be employed simultaneously to produce a satisfactory water quality.

In designing a water plant for use in cold climates, much thought is given to winter operation. The choice of coagulants, type of agitation for floc conditioning, capacity of settling basins (with allowance for ice thickness in extreme cases) and size of filter sand are major considerations. Some of these design factors impose a limitation on the plant operation at other periods of the year when cold water problems do not exist. By solving the low temperature coagulation difficulties many features of plant design can be changed and year-around economies result.

Means of Improving Low Temperature Coagulation

Mechanical means of improving low temperature coagulation have been generally unsuccessful. Longer periods for the conditioning and settling of the floc are frequently provided by the lower winter demand. While flash mixing and high velocity conditioning are recognized as outstanding advancements in warm water (producing better quality at lower chemical costs) they are shunned in winter operation. The old bugaboo of breaking up a fragile floc has necessitated a lowering of conditioning velocities. The best mechanical devices and the use of extremely fine filter sand have not assured good clarification.

It is now common practice to alter the characteristics of a water supply to improve coagulation. Adjustment of alkalinity and pH to a more favorable zone is accomplished with lime, soda ash, excess alum or sulfuric acid. Prechlorination and slime control with copper sulfate often assists. The addition of clay is sometimes resorted to when there is insufficient turbidity. More recently activated silica used in the coagulation process has proved its merit and has become accepted practice.

Water temperature cannot be economically raised to improve coagulation except at plants where a large percentage of the water can be passed through heat exchangers. By this means numerous industrial water plants, using surface supplies, treat at 50-70° F. even during subzero weather. Kansas City, Kan., and Wellsville, N. Y., are examples of large and small municipalities which benefit from a lesser temperature increase by operating in conjunction with a municipal steam power plant. The diversion of condenser water to eliminate intake ice troubles and to aid coagulation has been used at Winnetka, Ill.[1]

In the following discussion an attempt will be made to arrive at a fundamental explanation of the causes of poor winter coagulation and to describe methods which are successfully coping with this problem.

Effects of Low Temperature

The literature discloses considerable variance in views on the effect of low temperature on the rate of floc formation. Recent evidence, not yet complete because of the many factors involved, indicates that there is not much effect on rate of floc formation. There is, however, an apparent unanimity on the fact that the floc formed is slower settling and possesses less strength. The slower settling is attributed to the slightly greater water density and very appreciable increase in water viscosity. The failure of alum floc alone to develop the same magnitude of toughness in winter months that it does in other periods of the year has been considered to be the result of an "unknown influence."

An impressive evaluation of the effects of temperature on the rate of floc formation with Ferrisul was made by T. R. Camp, D. A. Root and B. V. Bhoota at the Massachusetts Institute of Technology.[2] These authors reviewed the generally accepted theory of floc formation and the effects of temperature somewhat as follows. The coagulation (or flocculation) process *per se* is the mechanism by which small colloidal or suspended particles coalesce and form larger particles.

The formation of floc takes place in three phases, according to these authors. The first phase is the production of molecular precipitates by means of chemical reactions which are so rapid as not to be affected materially by temperature when compared to the total time required for floc formation.

The second phase is the formation of colloidal floc particles. The molecularly dispersed and colloidal particles move about rapidly and collide with one another, whereupon they coalesce, forming larger particles until they reach a size that prevents them from moving about under their own kinetic energy. Upon reaching this upper limit of size of colloidal particles, they are still so small as to be barely discernible under the microscope. The speed of this phase of coagulation at 86° F. is twice that near the freezing point of water, but as only 6 to 10 seconds are required for completion of this phase, the effect of temperature is negligible.

The third phase brings the particles together by the mechanically induced motion of the water. The

*Parts I and II of this article are to be found in the September and October issues of this magazine.

speed of coagulation here was first considered to be proportional to the velocity gradient and independent of the temperature. Thus they concluded that the only appreciable effect of temperature might be that of shifting the optimum pH for floc formation when low dosages of coagulant are employed. A shift in pH of 0.3 unit was shown in these studies. The effect on floc settling was more significant since the velocity of settling varies inversely as the viscosity. For example, at 35° F. the settling period must be 73 per cent longer than at 70° F. to produce the same percentage removal by settling.

It should be pointed out that the M. I. T. authors, in minimizing the effect of temperature on the floc formation, studied coagulation in distilled water and for each temperature shifted the pH to an optimum. It is not known whether the optimum pH shift would be greater or less in natural water supplies. Also, the appraisal of the effect of temperature in the third phase was subsequently modified. Camp and Stein[3] revised the earlier view to acknowledge that a temperature drop from 80° F. to the freezing point would about double the kinematic viscosity and therefore the speed of flocculation will be reduced about 30 per cent by this change in temperature.

From the foregoing it would still be apparent that the effect of low temperature on floc formation, although appreciable, is hardly as important as the effect upon settling. No explanation is given for the "unknown influence" which apparently decreases floc toughness. It is certainly true that if the apparent density of the floc particle could be increased, that is, if the floc could be more completely dewatered, it would settle faster and would have greater toughness. The "protogel theory" of coagulation proposed by the author in the June issue of *Water and Sewage Works* may well provide an explanation for these additional considerations of floc formation, toughness, and settling.

TABLE I

Coagulated Matter Passing Filters, Collected on Cotton, and Ashed

Size of filter material in mm.	.606	.617*	.770	1.08	1.56
Average Feb.-Mar.-Apr. Tests—					
Ppm. ash from alum	.520	.596	.901	1.569	2.664
Ppm. ash from alum-silica	.018	.029	.029	0.072	0.226
% reduction by silica	96.5	95.1	96.8	93.4	91.5

*Anthrafilt.

Theory of Floc Formation

In the protogel concept it has been suggested that all of the water and impurities are at one time within a fibrillar network. As this is broken up and compacted by pressure differentials created in floc conditioning, the water must pass out through the interstices. As the floc particle first decreases in size and increases in apparent density, these pores become smaller and smaller until they reach such size that the viscosity of the water provides a resistance to flow which counterbalances further tendency for floc shrinkage. Then growth into larger flocs will provide the maximum toughness and best settling characteristics which can be attained under these conditions for formation. At low temperatures and high water viscosity the equilibrium will be reached with less dewatering of the floc and therefore less toughness and poorer settling.

In conjunction with mechanistic theories for floc formation it must be recognized that the chemical and colloidal balance is of greatest significance. In a mathematical treatment, Camp and Stein[3] have assumed that two particles in stream flow will necessarily collide if calculations indicate that they can be brought within a distance equal to one-half the sum of their two diameters. Such calculations might hold for inert matter but not for electrically charged colloidal particles which frequently constitute a floc. Even with greatly reduced charges on the particles one must expect some orientation rather than random arrangements. The colloidal chemistry explanation for floc formation is too involved for detailed discussion at this time, but it can reasonably be said that it is very important in understanding the mechanism of floc formation as well as of practical significance in meeting problems of difficult coagulation. The benefits of colloidal balance for overcoming the low temperature problem are a case in point.

Floc Toughened by Silica

In 1936 J. R. Baylis began publication of a series of articles in *Water Works and Sewerage* on improved coagulation. These articles are being increasingly recognized for their importance in the advancement of chemical treatment of water. Baylis' research led to the development of a process in which sodium silicate is reacted with sulfuric acid and aged. A product, referred to as "activated silica," is produced. It was found to have a pronounced effect upon the coagulation in Lake Michigan water.

Faster formation, greater toughness, and more rapid settling of the floc were noted along with an outstanding improvement in water quality. The Baylis method, another process developed by A. V. Graf and W. B. Schworm, and subsequent contributions by the Philadelphia Quartz Co., have been described elsewhere.[4,5] Alum, ammonium sulfate, chlorine, etc., may be employed with sodium silicate instead of sulfuric acid.

The silicate processes as originally developed were not immediately adopted on a wide scale because the limiting factors, both in preparation and application of the activated silica, were not well understood. More recently, however, these factors for proper control have become known through research in which the writer has cooperated.[6,7] (See parts I and II of this series.) In addition, continuous means for activating the silica have been developed as a substitute for former batch preparation.[4,7] Today, successful service records of one to four years' continued use have been obtained on waters treated for clarification, softening, and color removal.

As a result of the new experiences, recommendations, and process simplifications, the silica coagulant aids are employed at a large number of plants. The smallest treats 0.1 mgd., whereas the Chicago South District Filtration Plant, which is now being completed, is the world's largest and will be able to treat 432 mgd. during the winter months with the Baylis process. In Florida ten water plants, all of them treating less than 3 mgd. and none, of course, operating on cold water, use silica coagulant aids. In Minnesota, where cold water is definitely a problem, N-Sol-A (N-brand silicate reacted with ammonium sulfate) is used for year around operation.[6]

Superior Cold-water Coagulation

When Baylis investigated the effects of silicate treatment on the quality of water, he found that the greatest value was obtained during the winter months. His principal conclusions will be reviewed and the data which he accumulated during the cold water months of February, March, and April will be presented here in revised form so that the values of the silicate processes may be even more apparent. His original article[5] may be consulted for the full details of the study.

Using a large pilot plant equipped with five filters which treated slightly more than 0.23 mgd., Baylis determined the amount of suspended material which passed through different size filter media. *The object was to determine whether or not a very high quality water could be obtained while filtering cold water through coarse sand at a rate of 3.2 gallons per sq. ft. per min.*

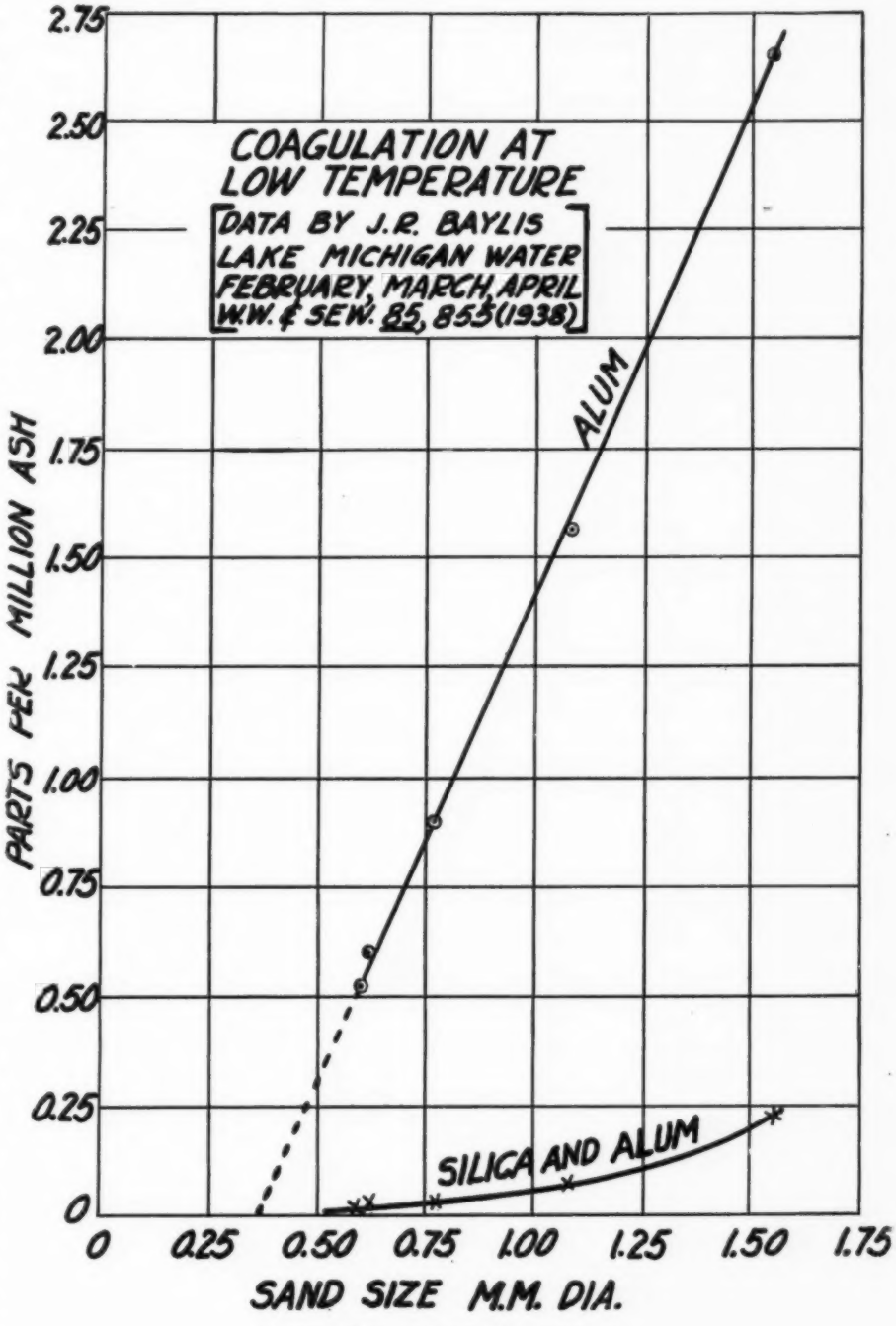
The quality was measured much more accurately than is possible with turbidimeters. The filtered water was continuously sampled and caused to pass through a cotton plug. The cotton was then ashed to obtain a measure of the amount of suspended material which passed the coarse filters. By this method of determining water quality, even an excellent coagulation (one which produces a sparkling water), shows easily detectable amounts of coagulated matter passing the filters.

During the experiments, the amount of alum used was varied as required to obtain good coagulation. The silica dosage, expressed as SiO_2, approximated 40 per cent of the alum except when lower amounts were employed. Occasionally the results were such as to lead Baylis to the conclusion that they could have been improved had a larger amount been added. The averages of all tests for the cold water period of February, March, and April are presented in Table I and in the accompanying graph. The data comprise tests of alum alone on 22 days and of silica and alum on 14 days.

Baylis found that alum alone did not produce good coagulation of Lake Michigan water during certain periods and stated that "such periods almost invariably occur when water is at a low temperature. The low temperature and lack of suspended matter in the water which helps reinforce the coagulation probably are the major causes."

Choosing an exceptionally high standard for quality but one which will be increasingly demanded in the future, Baylis concluded that "the ash of the coagulated material found after burning the cotton plugs should average not more than 0.025 ppm." Referring to the use of alum, he continues, "This standard probably would not have been attained with sand of 0.5 mm. effective size and a filtration rate of 2 gal. per sq. ft. per min. during the periods of weak coagulation. The Baylis data show that not once did alum alone reach this standard during February, March, or April with the high rate of filtration. On the other hand, the silica-alum average was 0.016 ppm. for 0.606 mm. sand, 0.029 ppm. for 0.617 mm. Anthrafilt, and also 0.029 ppm. for 0.770 mm. sand. Several tests showed as little as 0.003 and 0.004 ppm. ash.

The Baylis studies on the use of activated silica were made in a pilot plant of conventional floc conditioning and settling design. Outstanding results have also been obtained in the operation of upflow plants. Noreus[6] noted improved color reduction, lengthened filter runs, decreased silica content, and doubled plant capacity. In addition to obtaining these advantages, Noreus more recently summarized his low-temperature coagulation experience in the following statement[9]: "With winter operating conditions we were forced to increase the silica treatment about 100 per cent to obtain equivalent settling conditions as compared to summer. In past years, winter conditions always resulted in poorer quality finished water, whereas with the silica treatment we have now completed twelve months of operation, during which we have encountered no difficulty in maintaining



Coagulation at Low Temperature.

Data by Baylis showing the comparative effectiveness of alum alone, and alum plus silica in the coagulation of cold water

(This chart appeared in Part II through an error. It belongs with this article on low temperature coagulation.)

desired water quality regardless of raw water temperature or quality."

The N-Sol activated silica process also proved its value in a cold-water study conducted at Malartic, Quebec. Periods of "trouble" occur at this plant due to formation of light fluffy floc which fills the settling basin within a few days. Prior to a test of silica, the basin had to be cleaned after four days of operation. The addition of 3.5 ppm. activated silica from 12.0 ppm. sodium silicate established a record for the trouble periods of sixteen days' running without cleaning. An even longer run could probably have been obtained with a higher silica dosage. The next run on alum alone was of only three days' duration. The superintendent, Mr. William Duff, further reported that the clarity of water in the settling basin during the activated silica test was the best ever observed.

Such improvements in the character of low temperature coagulation have become commonplace among users of the activated silica processes. It is evident that in some manner a fundamental deficiency of the alum floc is remedied by the introduction of activated silica.

Explanation for Improvements

Most of those who have explained coagulation to the water-treating profession have oversimplified the nature of the processes involved. Too much emphasis has been placed upon the elementary chemistry and too little on the colloidal factors which form the basis for the most reasonable explanation. Until very recent years coagulation was improved by shifting the pH to a "zone of optimum coagulation." This is successful in some cases but in others leaves much to be desired. Colloid chemists have long recognized this means of improving coagulation but they also have been fully aware of another possibility which was little used in water treatment. The principle of mutual coagulation applies over a wide range of pH and teaches that optimum coagulation can be obtained by adjusting the balance of colloids of opposite electrical charge.

If coagulation is attempted with alum alone, in the normal pH range for clarification, a positively charged colloid may be obtained which can usually have its charge decreased by shifting the pH. At the optimum condition for coagulation the charge is the smallest possible. In some waters the naturally existing clay may provide sufficient negative charge to neutralize the positively charged alum and permit good clarification without pH adjustment. In other waters it has been found that the addition of clays of high negative charge improved coagulation.

Unfortunately this use of clay was too exclusively interpreted as merely "giving weight to the floc." Activated silica is a material of such small particle size and the amount used is so little as compared to clay that another reason must exist for the heavy floc obtained with it. With silica it is generally unnecessary to adjust the pH to obtain optimum coagulation. Simple neutralization of charges seems to be involved and, in view of this, it can be readily understood why the more finely dispersed activated silica of controllable negative charge is reported to be superior to clay.[6]

By establishing a proper balance of electrical forces there is less tendency for the colloidal system to remain in a dispersed state (no floc) or a partially dispersed state (weak floc). Equalization of positive and negative charge permits the floc to compact itself to the greatest possible extent and produces toughness. As was previously mentioned, the tendency for the colloids to reduce their volume may be offset in part by their assuming a gel structure which provides resistance to further compacting. The outward movement of water from such a gel structure is impeded by the submicroscopic pore size and also any increase in viscosity of the water would increase resistance to floc shrinkage.

Optimum clarity of water is obtained when the colloids and suspended matter are most efficiently removed. In an unbalanced system, where colloids of one charge predominate, it is possible to obtain a reasonably good floc without complete removal of the colloidal matter. In a properly adjusted system which is mechanically handled in the best manner, one will simultaneously obtain brilliant clarity and the floc formed will be more compact (tougher) and will settle more rapidly.

The choice between adjusting pH or establishing a balanced condition through the use of a negatively charged colloid, such as activated silica, depends upon the relative economy, convenience, and efficiency in producing a heavy floc under conditions otherwise unfavorable for coagulation. The fact that silica use has been found successful where all attempts at pH adjustment failed[6] indicates that the principle of mutual coagulation may have more merit than the previously applied principle of shifting the pH. This appears to be particularly substantiated in the problem of low temperature coagulation.

Effects Upon Plant Design and Operation

Fear has been responsible for many design features now to be found in water plants which produce a product whose quality is considerably poorer than that which is desirable. Fear of not forming a floc, or of breaking it up, or that the floc will not settle, or that it will penetrate the filters, has caused the installation of features which admittedly are detrimental to operation during other times when the feared conditions do not prevail. Low temperature has been one of the most feared conditions ever since chemical treatment of water supplies was introduced. To a very large extent this condition may be overcome through adoption of the principle of mutual coagulation.

Within certain limits one can now choose the pH range at which he wishes to coagulate and still obtain optimum clarification. (Factors such as color removal limit this choice.) Since all of the added silica is removed with the alum floc and there is only a minor introduction of other reaction products as compared to previous techniques of shifting the pH or alkalinities, the finished water can more nearly approximate the raw water in composition. Increased capacity from existing equipment or economies in new designs are feasible. It is no longer necessary nor advisable to employ fine filter sand where competent plant operation and adequate chemical treatment is provided. Most important is the assurance that in many cases there will be "no difficulty in maintaining the desired water quality regardless of raw water temperature or quality."

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ROCKY MOUNTAIN SECTION MEETS IN ROMANTIC SANTA FE

A Report by
HARRY A. FABER*
Editorial Associate
WATER AND SEWAGE WORKS

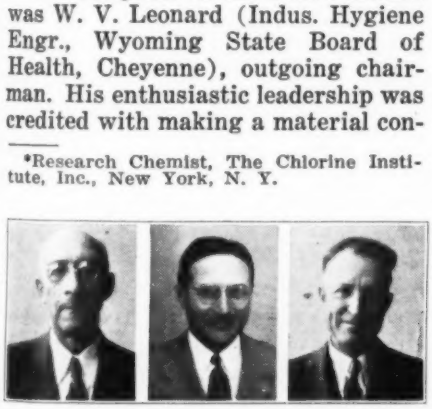
THE Rocky Mountain Section of the A. W. W. A. held its 20th Annual Meeting in Santa Fe, New Mexico, on September 12th and 13th. An attendance of nearly one hundred members was representative not only of the states of Colorado, New Mexico, and Wyoming, but included association members from points as distant as New York and San Francisco.

Headquarters of the meeting was the noted La Fonda Hotel, named after the rendezvous of famous and infamous early westerners at the end of the Santa Fe trail. In contrast to the historic background, however, this meeting was concerned with bringing forth the most modern developments in water treatment. The technical program also included round table discussions on public relations and on problems of water superintendents. Tribal dances and music of the Hopi Indians constituted a unique feature at the association banquet.

At the business luncheon, Wendell R. LaDue, President of the A. W. W. A. (Chief Engr. and Supt., Bureau of Water and Sewerage, Akron, Ohio), commented on the mutual benefits derived from the association of one water works man with another. He discussed the present day necessity of applying knowledge to finding new solutions for plant operation problems.

The recipient of the Fuller Award was W. V. Leonard (Indus. Hygiene Engr., Wyoming State Board of Health, Cheyenne), outgoing chairman. His enthusiastic leadership was credited with making a material contribution to the growth of the Rocky Mountain Section.

*Research Chemist, The Chlorine Institute, Inc., New York, N. Y.



Programmers
D. D. Gross, Chief Engr., Denver Water Dept. (AWWA Director).
C. T. Wright, Senior Sanitary Engineer, U.S.P.H.S., Denver.
C. A. Truman, Supt., Northfield Water & Land Co., Colorado Springs.

Officers Elected

New officers elected to serve for the forthcoming year are:
Chairman—Maynard Graham, Water Supt., Loveland, Colo.

Officers and Wheelhorse
W. V. Leonard (Chairman), Industrial Hygiene Engr., Wyoming State Dept. Health, Cheyenne. (Voted the Fuller Award.)
O. J. Ripple (Secy.-Treas.), Consulting Engineer, Denver.
Chas. A. Davis, City and County Engineer, Denver.

Vice-Chairman—George A. Nesbit, Supt., Water Dept., Palisade, Colo.
Secy.-Treas.—O. J. Ripple, Consulting Engineer, Denver, Colo.

Two trustees, elected for terms of three years, are: T. H. Baldwin, Consulting Engineer, Cheyenne, Wyo., Carl C. Jones, Water Commissioner, Sidney, Neb.

Technical Papers

"Photo-Micrographs of Microorganisms," by George J. Turre, Chief Chemist, Denver Water Dept., Denver, Colo.

One of the few U. S. specialists in the photography of algae important in water treatment, Mr. Turre preceded his showing of slides with a review of algae control methods. Copper sulfate and chlorine have proved most effective for such preventive treatment; "Benochlor" can be used when the water is not employed as a potable supply; arsenious compounds kill algae but are generally hazardous materials to handle; and a new copper sulfate-citric acid compound has been found to possess good algecidal properties for the treatment of condenser cooling water.

Other control measures include covering of reservoirs to restrict growth due to sunlight and the black-out method which utilizes activated carbon to decrease the penetration of sunlight. The health aspect of copper salts in water was commented on; the amount employed for algae control was shown to be much lower than the concentrations present in many natural foods and in some medical treatments.

"General and Fundamental Aspects of Water Treatment," by Ashley G. Classen, Consulting Engineer, El Paso, Texas.

Mr. Classen's paper was read, in his absence, by W. H. Booker. Two important conclusions regarding water supplies of the Southwestern States are: Conservation of water is essential, and there is no community or industry without treatment problems. In this area, where the earth's surface is highly mineralized, a high solids content is characteristic of nearly all water supplies.

Mr. Classen described the sodium chloride content as creating a most difficult removal problem, despite the recent application of resin exchangers for this purpose. Hard water has never been shown to be physiologically harmful, but it is expensive because of the excessive soap consumption, incrustation of pipes and hot water heating systems. Methods of softening water were discussed and evaluated for communities of different size.

"Chlorine and Its Uses," by Harry A. Faber, Research Chemist, The Chlorine Institute, Inc., New York, N. Y.

Modern methods of chlorination and of chlorination control have proven effective in meeting higher

Denver Engineers
B. V. Howe, Consulting Engr., Denver.
C. L. Morgan, Crocker and Ryan, Engineers, Denver.
John Burgess, Engr. and Asst. Secy., Denver Water Dept.

standards of bacterial quality. Mr. Faber reviewed the development of chlorination practices, with special emphasis on new residual testing methods which now make possible the differentiation of residual chlorine into free available chlorine and combined available chlorine. Free available chlorine residuals are rapidly bactericidal, oxidize iron and manganese, and destroy many tastes and odors present in water. The combined available chlorine residuals are more slowly bactericidal, but persist for long periods of time. Proper control thus permits use of the type of chlorine treatment most suited to a particular problem.

"Observations of European Water Supplies," by L. O. Williams, State Sanitary Engineer, Cheyenne, Wyo.

The water supplies of Heidelberg, Weisbaden and other German municipalities were reported on in Mr. Williams' paper. One of four divisions in the Reich government was the Public Health Section; this, like all others, was permitted no autonomous action. Municipal problems were usually solved by local developments; springs and wells supplied eleven different pressure levels in Heidelberg with corrosive water, and Magnomass (calcium and magnesium carbonate) was employed to remove carbon dioxide and manganese.

The Weisbaden supply depended in part upon horizontal tunnels into elevated strata of water-bearing hills, and in part on filtered ground water. In both cities, the small scale use of chlorination and of the Katydn silver process were depended upon for disinfection.

"Water Works Accounting and Retirement Plans," by G. D. Morgan, Office Manager, Denver Water Dept., Denver, Colo.

In an exceptionally practical paper, Mr. Morgan pointed out that, especially for small municipalities, accounting procedures must be usable if they are to be of value. The basis of rate charges, collection procedures, continuous records of maintenance and operating costs, and systematic records of all operations at all times, are features of basic importance.

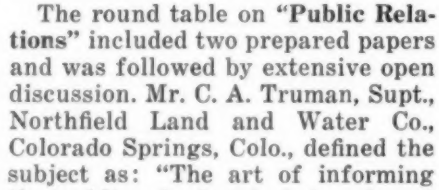
Programmers

Geo. J. Turre, Chief Chemist, Denver Water Dept.
G. D. Morgan, Office Manager, Denver Water Dept.
L. O. Williams, State Sanitary Engr., Cheyenne, Wyo.

Retirement plans should be planned with the aid of an experienced actuary, in order to provide an income sufficient to meet liabilities. Such plans, which retire old employees and advance young ones, are advantageous to employer and employee alike. Except in general principles, retirement plans must be specially designed for particular situations. State-wide retirement plans seem to provide the best solution for the smaller municipalities.

Round Table Discussions

The round table on **"Public Relations"** included two prepared papers and was followed by extensive open discussion. Mr. C. A. Truman, Supt., Northfield Land and Water Co., Colorado Springs, Colo., defined the subject as: "The art of informing the public of what is being done," explaining direct and indirect methods of accomplishing this. Direct methods, relatively small in cost but bringing large returns, include: "dressing up" the plant, the employees, and the offices; encouraging visits of local groups; and press and radio publicity in human interest stories. Indirect methods include good service and fair rates to consumers. Mr. D. D. Gross, Chief Engr., Denver Water Dept., Denver, Colo., considered water quality, quantity, and reliable service to be essential, but stressed the need for consideration in dealing with the public. Mr. LaDue described the careful development of studies and of a national program in the field of public relations which the A. W. W. A. is now undertaking.



Host and Engineers

R. D. Anderson, Supt., New Mexico Power Co., Santa Fe, N. M.
G. E. Riepe, State Sanitary Engr. for Colorado, Denver.
W. H. Booker, State Sanitary Engr. for New Mexico, Santa Fe, N. M.

The round table on **Problems of Water Superintendents** was shortened by lack of time, but discussions by Messrs. Truman and Ripple evoked much interest. The experience reported by Mr. Truman with thermal activity which prevented flow in an exposed wood stave pipe, was considered most unusual. Mr. Ripple listed pretreatment of water, the use of surface wash methods, and proper underdrain systems as most essential to the prevention of mudballs in filters. He described the proper design required for each of these factors.

Two motion pictures were included in the program: the "Clean Water" feature, prepared by General Electric Company, was discussed by Chas. T. Wright, Senior Sanitary Engineer, U. S. P. H. S., Denver. L. L. Wilkinson, Mayor of Greeley, Colo., presented a beautiful "public relations" color movie prepared by the city of Greeley.

A Ladies' Entertainment Committee provided opportunities for visits to places of civic interest and to homes of Santa Fe, in addition to social affairs featured on the program.

The sessions of the Water Works Association followed an intensive one day meeting of the Rocky Mountain Sewage Works Association, which was planned so that many members could attend sessions of both groups.

Wirts Resigns at Cleveland Easterly Plant

John J. Wirts, Superintendent of the Easterly Sewage Treatment Works at Cleveland, Ohio, has resigned that position effective December 1 of this year. "Jack," as he is familiarly known throughout the field of sewage treatment, will become Personnel Manager of Towmotor Corp. of Cleveland, O. The Towmotor Corp. manufactures a complete line of lift trucks and tractor equipment for moving materials.

During his tenure as superintendent of the Easterly plant Mr. Wirts has contributed articles of distinctive value to this magazine, in addition to his several papers presented in technical meetings.

MODERN PRACTICES IN MUNICIPAL WATER SOFTENING

By S. B. APPLEBAUM, PRES.
LIQUID CONDITIONING CORP.
NEW YORK

MUNICIPAL water softening started in England about 60 years ago. The first municipal water softener in the United States of the Lime-Soda type was installed about 40 years ago, and the first municipal Zeolite water softener about 20 years ago.

Since that time, the number of municipal water softening plants that have been installed in the United States has grown rapidly as evidenced by Fig. 1.[1] This growth is caused by a greater realization of the benefits and savings which municipal water softening can provide, as well as the elimination of difficulties which the hardness of a water supply causes to the citizens of a community using it for household and industrial purposes. It is predicted that by 1950 there will be over 1000 municipal water softening plants in the United States of both the Lime-Soda and the Zeolite type.

The hardness to which waters are softened in municipal plants is gradually being reduced. Not too many years ago, it was considered good practice for a city to deliver a water of a hardness of up to 10 grains per gallon, or 171 ppm, as $CaCO_3$. Today municipal water softening plants are aiming at much lower figures, down to 3 to 5 grains per gallon, or 51 to 85 ppm.

W. D. Collins made a study of the municipal supplies in the United States of over 600 cities, and Table I[2] shows the population, in thousands and in per cent of the total, that was served with water of various amounts of hardness in 1932. Table II[2] gives the same information for Canada as studied by Leverin in 1938.

These tables indicate that the trend is towards a softer water for municipal application but that there is still opportunity for future installations of water softening plants where the hardness of the raw water exceeds about 120 ppm as $CaCO_3$.

BENEFITS FROM MUNICIPAL WATER SOFTENING

Soap Saving

W. H. Hudson made an interesting study comparing the cost of soap and other detergents in communities

The Author

using hard water with their cost in communities using soft water. The hard water cities studied were Bloomington, Urbana, and Chicago Heights, Illinois. These were compared with a soft water community, Superior, Wisconsin. Fig. 2[2] shows the annual cost of soap per capita, assuming soap at 16c per pound in these communities, plotted against the hardness.

The reason more soap is used in hard water communities is that the hardness reacts with the soap to form insoluble soap curds. These curds have no lathering effect and represent a wastage of soap by the hard water. The lather, which is desired when soap is used, can only be obtained after all of the hardness in the raw water has been consumed in making these curds. In this way, the soap acts as a water softening chemical. When all of the hardness has been destroyed, additional soap used forms the lather.

Troubles Caused by Soap Curds

In addition to wasting soap, the curds formed are very objectionable. They are present as a milky white precipitate in the water used in contact with the soap. This is apparent when taking a bath in hard water. Perfectly softened water in a bathtub stays clear, and the soap employed makes a luxuriant lather that floats on top.

Curds also form the well known bathtub ring which is hard to clean and disagreeable in appearance. The curds also deposit on hair, skin, etc. That is why so many beauty parlors have installed small water softeners.

In the laundry, curds form deposits on linens, causing them to be yellowish in appearance and also rancid in odor. Soft water not only improves the appearance of the linens but prolongs their life by virtue of the fact that less bleaching is required.

Cleaning of dishes and glassware is difficult in hard water, and the contrast in appearance when using soft water is outstanding.

TABLE I

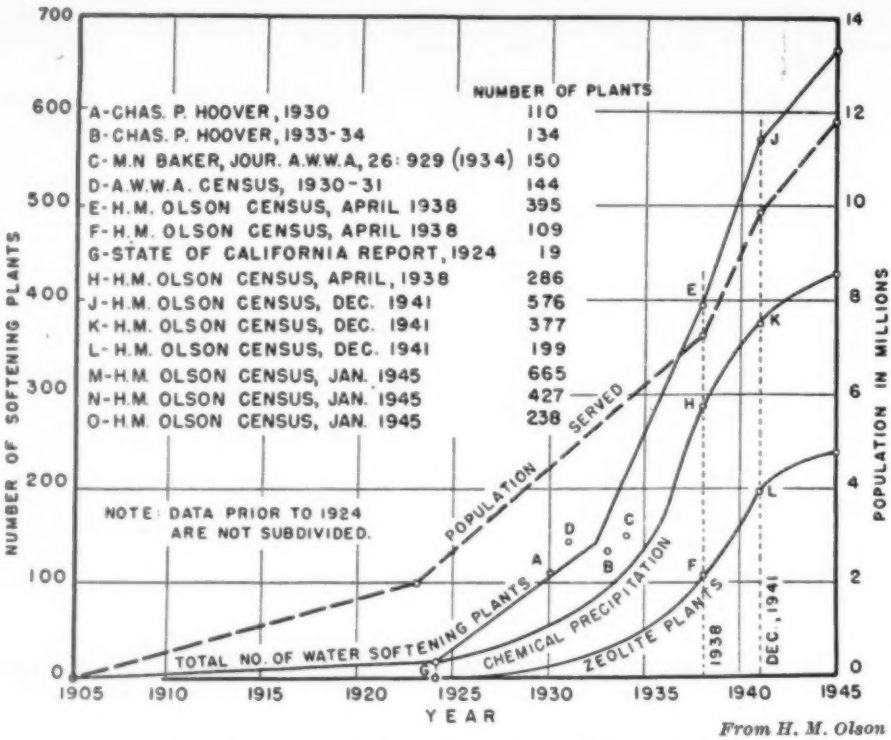
Varying Hardness and Population Served in U. S. in 1932

RANGE OF HARDNESS	POPULATION IN THOUSANDS	PER CENT OF TOTAL
parts per million		
1–60	20,372	29.5
61–120	18,536	26.9
121–180	10,579	15.3
More than 180	7,209	10.4
	56,696	82.1

TABLE II

Varying Hardness and Population Served in Canada in 1938

RANGE OF HARDNESS	POPULATION IN THOUSANDS	PER CENT OF TOTAL
parts per million		
1–60	907.9	16.3
61–120	1,458.7	26.2
121–180	1,057.2	19.0
181+	361.3	6.5
	3,785.1	68.0


NUMBER OF PLANTS
A-CHAS. P. HOOVER, 1930 110
B-CHAS. P. HOOVER, 1933-34 134
C-M.N BAKER, JOUR. A.W.W.A, 26: 929 (1934) 150
D-A.W.W.A. CENSUS, 1930-31 144
E-H.M. OLSON CENSUS, APRIL 1938 395
F-H.M. OLSON CENSUS, APRIL 1938 109
G-STATE OF CALIFORNIA REPORT, 1924 19
H-H.M. OLSON CENSUS, APRIL, 1938 286
J-H.M. OLSON CENSUS, DEC. 1941 576
K-H.M. OLSON CENSUS, DEC. 1941 377
L-H.M. OLSON CENSUS, DEC. 1941 199
M-H.M. OLSON CENSUS, JAN. 1945 665
N-H.M. OLSON CENSUS, JAN. 1945 427
O-H.M. OLSON CENSUS, JAN. 1945 238
NOTE: DATA PRIOR TO 1924 ARE NOT SUBDIVIDED.
POPULATION SERVED
TOTAL NO. OF WATER SOFTENING PLANTS
CHEMICAL PRECIPITATION
ZEOLITE PLANTS
1938
DEC., 1941
NUMBER OF SOFTENING PLANTS
POPULATION IN MILLIONS
YEAR
1905 1910 1915 1920 1925 1930 1935 1940 1945
0 100 200 300 400 500 600 700
0 2 4 6 8 10 12 14

From H. M. Olson

Fig. 1. Growth of Municipal Water Softening Plants.

Saving in Plumbing Repairs

Hard water when used in hot water heaters causes a scale to form which plugs the coils of heaters, and requires expensive plumbing repairs. This has been estimated by the Michigan State Department of Health[3] to average about $4.00 per family per year.

Effect of Hard Water in Cooking

Hard water toughens vegetables. Soft water makes for greater tenderness, better taste and improved color. It also improves the flavor of coffee and tea.

Fuel Loss

Hard water forms scale which wastes fuel. It has been estimated that this waste averages about $1.50 per person per year.

In the case of industrial plants, the scale caused by hard water in boilers not only causes fuel wastage, but shutdowns of the boilers for cleaning and tube losses due to burning out of tubes. Consequently, most modern industrial boiler plants install water softeners to remove the residual hardness left in the treated water by municipal water softeners.

METHODS FOR MUNICIPAL WATER SOFTENING

The two methods which have been used for municipal water softeners are: a) Cold Lime-Soda Ash process, b) Sodium Zeolite Process.

Cold Lime-Soda Process

This method of reducing hardness was one of the first to be developed. It consists of adding lime (Clark Process) to react with bicarbonate hardness, and adding soda ash (Porter Process) to react with the sulfate and chloride hardness. The chemical reactions involved are as follows (underlined compounds are precipitated).

LIME REACTIONS

Calcium Removal

$$Ca(HCO_3)_2 + Ca(OH)_2 = \underline{2CaCO_3} + 2H_2O$$

Magnesium Removal

$$Mg(HCO_3)_2 + Ca(OH)_2 =$$
$$\underline{Mg(OH)_2} + 2\underline{CaCO_3} + 2H_2O$$

Carbon Dioxide Removal

$$CO_2 + Ca(OH)_2 = \underline{CaCO_3} + H_2O$$

SODA ASH REACTIONS

Calcium Removal

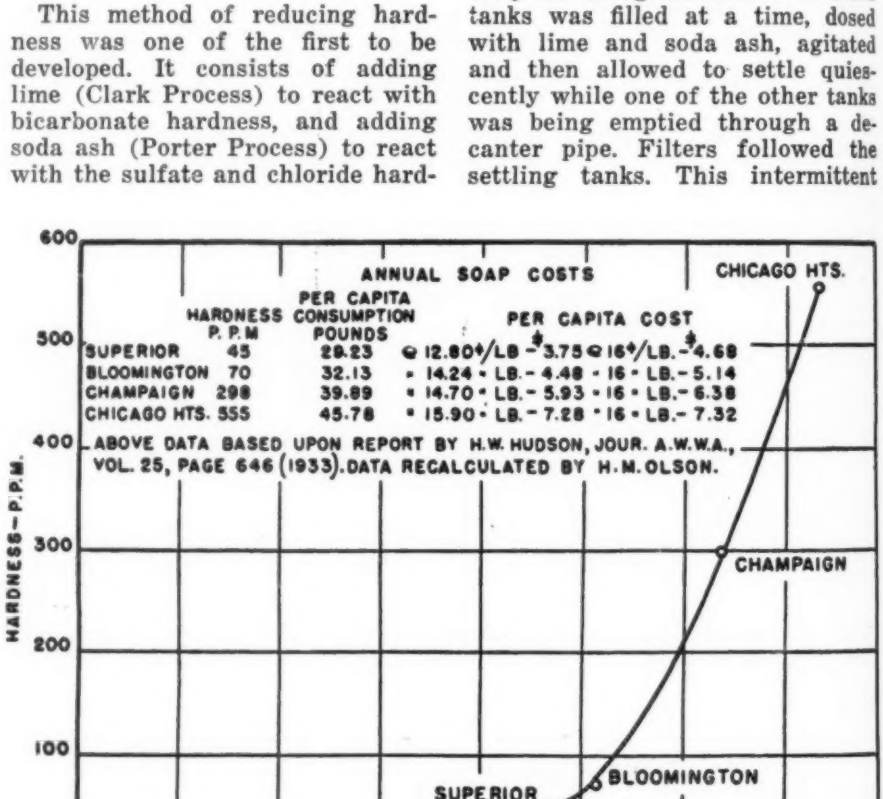
$$Ca\begin{Bmatrix}Cl_2\\SO_4\end{Bmatrix} + Na_2CO_3 = \underline{CaCO_3} + \begin{Bmatrix}2NaCl\\Na_2SO_4\end{Bmatrix}$$

Magnesium Removal

$$Mg\begin{Bmatrix}Cl_2\\SO_4\end{Bmatrix} + Na_2CO_3 + Ca(OH)_2 =$$
$$\underline{Mg(OH)_2} + \underline{CaCO_3} + \begin{Bmatrix}2NaCl\\Na_2SO_4\end{Bmatrix}$$

Cold Lime-Soda Softeners

The early forms of Cold Lime-Soda Softeners were of the intermittent type, consisting of several batch tanks equipped with mechanically driven agitators. One of these tanks was filled at a time, dosed with lime and soda ash, agitated and then allowed to settle quiescently while one of the other tanks was being emptied through a decanter pipe. Filters followed the settling tanks. This intermittent


ANNUAL SOAP COSTS
CHICAGO HTS.
PER CAPITA HARDNESS P.P.M
PER CAPITA CONSUMPTION POUNDS
PER CAPITA COST
SUPERIOR 45 28.23 @ 12.80¢/LB - $3.75 @ 16¢/LB. - $4.68
BLOOMINGTON 70 32.13 • 14.24 • LB. - 4.48 • 16 • LB. - 5.14
CHAMPAIGN 298 39.89 • 14.70 • LB. - 5.93 • 16 • LB. - 6.38
CHICAGO HTS. 555 45.78 • 15.90 • LB. - 7.28 • 16 • LB. - 7.32
ABOVE DATA BASED UPON REPORT BY H.W. HUDSON, JOUR. A.W.W.A., VOL. 25, PAGE 646 (1933). DATA RECALCULATED BY H.M. OLSON.
CHAMPAIGN
BLOOMINGTON
SUPERIOR
HARDNESS - P.P.M.
ANNUAL SOAP COST PER CAPITA - DOLLARS
SOAP COSTS COMPUTED AT 16 CENTS PER LB.
0 100 200 300 400 500 600
0 1 2 3 4 5 6 7 8

From H. M. Olson

Fig. 2. Soap Cost Curve Based on Soap Cost at Uniform Basis of 16 Cents per lb.

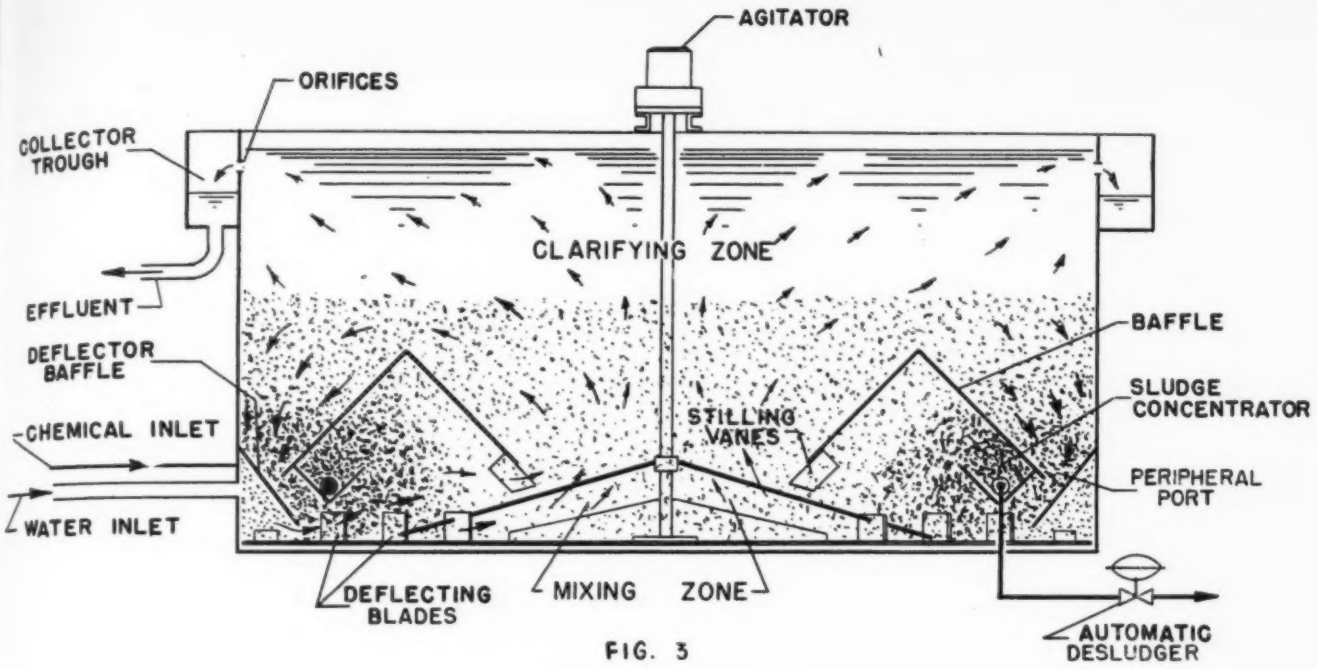


Fig. 3. Sludge Contact Reactor.

type requires excessive space for the tanks and labor for operation of the various steps described.

The next form developed was the continuous type. The water flowed continuously into the settling tank, where it was mixed with a continuous and controlled stream of the lime and soda ash slurry, while settling of the precipitates took place at the same time. This saved labor of attention. The tanks had to be made large enough and properly baffled so that the velocities employed did not interfere with settling and so that there was a minimum of dead areas and channelling or short-circuiting areas.

The cold temperatures involved however interfered with rapid attainment of equilibrium. The precipitates formed were very finely divided and hard to settle. Reactions continued after the water left the settling tank; that is, the treated water was unstable. As a result some of the precipitates continued to form and deposit in the treated water lines and equipment. To stop these after-reactions, carbonation (addition of free CO_2 gas) or acid treatment was applied to the treated water to reduce the pH-value by neutralizing the excess of reagent.

Sludge-Contact Reactor

The development of the sludge-contact reactor was a considerable step forward to render the cold lime-soda treated water more stable. The contact with large quantities of previously accumulated precipitates stimulated rapidity and completeness of reaction. This is the modern unit employed in Cold Lime-Soda treatment today. It accomplished, in less than one hour, results equal or superior to those obtained with the old-fashioned continuous unit using four or more hours' retention. Chemicals are saved and a more stable water is produced. So stable is the treated water that some have called these sludge-contact reactors "Stabilizers."

Before the sludge-contact softener was developed, sludge recirculation was practised by which some of the settled sludge was pumped back to the inlet of the agitator or flocculation chamber. But this frequently resulted in imparting undesirable tastes and odors to the waters, especially in the summer when the settled sludge may have fermented.

The development of this type of reactor provided for Sludge Contact without allowing the sludge to settle. It thus avoided the re-pumping or recirculation of settled sludge, and also eliminated expensive sludge scraping, or collecting devices. Fig. 3 shows a typical sludge-contact reactor. It combines four functions:

(1) Proper agitation and mixing of chemicals and water; (2) sludge contact with a suspended deep sludge bed (blanket) of previously accumulated precipitates; (3) separation of the sludge from the water as the clear water emerges at the top of the unit; and (4) sludge concentration in internal concentration compartments in order to reduce the volume of sludge blow-off water discharged to waste.

The design *economizes* in space and in chemicals, producing better results in a fraction of the time required by the old-fashioned mixer and settling tank. It is used equally well for coagulation of turbid and colored waters, for softening of hard well waters by lime-soda, or for simultaneously softening and clarifying hard river waters. It is also efficient in absorption problems such as the removing of silica or fluorides by contact with magnesium compounds in the sludge.

In the design shown in Fig. 3, the precipitates formed by chemical addition are not allowed to settle out but are kept suspended by the slowly rotating agitator operating over the entire bottom of the tank. The water and chemicals enter the mixing zone near the bottom at the side where mixing is most efficient because of the relatively high tip speed of the agitator arm. The deflector baffle together with the deflecting blades induces the water to flow towards the central port, through which the sludge and water rise into the clarifying or sludge separating zone. The water then flows radially and outwardly towards the orifices of the peripheral collecting trough. The radially outward travel of the water takes place in the unrestricted clarifying zone at gradually decreasing velocities until a velocity is reached

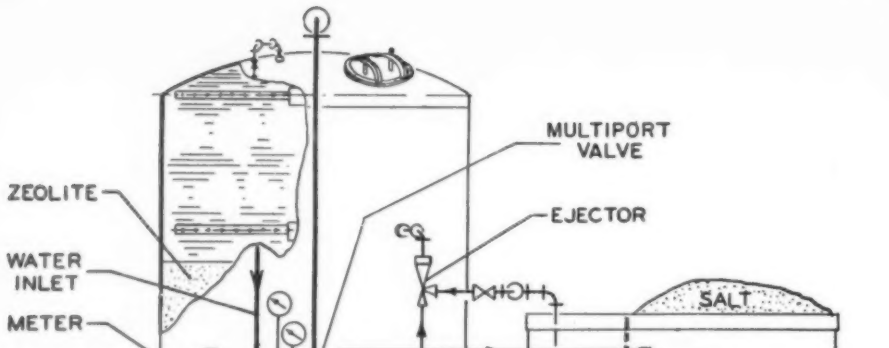


Fig. 4. Zeolite Softener with Multiport Valve.

sufficiently low to permit efficient separation of the water from the sludge.

Some of the water and sludge recirculate by returning through the peripheral port to the mixing zone. This recirculation ensures complete utilization of the chemicals. The top of the sludge is maintained above the inclined baffle separating the two zones.

Sludge-contact reactor units are built cylindrical in shape for economy of construction and the outer shell can be made of steel, wood or concrete.

Some of the sludge is collected in the sludge concentrator, where it is thickened or concentrated several times as compared with the strength of the suspended sludge bed (blanket). Automatic desludging devices blow off enough of this concentrated sludge to the sewer so that the top of the suspended sludge is kept at the optimum level for the best chemical results consistent with the clearest effluent.

The sludge-contact reactor has three outstanding features:

1) Positive recirculation of sludge as the arrows indicate so that all of the chemical present is completely utilized and so that there are no dead areas in the tank.

2) A large slow moving agitator operating over the entire bottom of the tank. This prevents any settling out and depositing of sludge on the floor of the tank. It avoids shutting down the reactor for cleaning such deposits or the use of separate sludge scraping devices for this purpose.

3) Horizontal radial flow, as distinguished from upflow through a sludge blanket, permitting the use of smaller diameter tanks without the danger of sludge carry-over because sludge particles separate more easily from a horizontal stream than from a vertically upflowing stream.

Sodium Zeolite Process

The Sodium Zeolite Process is one of the most efficient methods of water softening. Essentially it comprises a container having a bed of the zeolite or sodium cation exchange material, supported on gravel or anthrafilt, below which is an efficient collection or underdrain system. As the water passes downward through the sodium zeolite, the calcium and magnesium cations in the water are exchanged for the sodium of the zeolite. When most of the available sodium has been exchanged so that the first trace of hardness appears in the effluent, the zeolite is back-washed and then regenerated or revivified by passing a solution of common salt through it. Sea water, if available, may be employed for regeneration. The excess brine is rinsed out and the unit is restored to service. A meter is provided to guide the operator in regenerating after a definite number of gallons of water has been softened, or to actuate automatic regeneration. The chemical reactions involved are as follows (the symbol Z represents the zeolite):

OPERATING REACTION

$$Na_2Z + \begin{Bmatrix} Ca \\ Mg \end{Bmatrix} \begin{Bmatrix} (HCO_3)_2 \\ Cl_2 \\ SO_4 \end{Bmatrix} = \begin{Bmatrix} Ca \\ Mg \end{Bmatrix} Z + \begin{Bmatrix} 2\ NaHCO_3 \\ 2\ NaCl \\ Na_2SO_4 \end{Bmatrix}$$

REGENERATING REACTION

$$\begin{Bmatrix} Ca \\ Mg \end{Bmatrix} Z + 2\ NaCl = Na_2Z + \begin{Bmatrix} Ca \\ Mg \end{Bmatrix} Cl_2$$

Suitable multiport or individual gate valves are provided to control the operations. The regenerant solution is distributed inside the unit through a perforated pipe system to avoid channelling. Incoming hard water or outgoing dirty backwash water is likewise distributed or collected by a similar pipe system at the top. Fig. 4 shows a standard unit and salt tank with a multiport valve.

Several types of material are available for the sodium cation exchange material, such as glauconite, synthetic gel, and synthetic resin.

Resin, the most modern cation exchanger, is non-siliceous and therefore does not import silica to the treated water. Silica is objectionable for boiler feed purposes. Resin has a high capacity, several times as great as some of the old-fashioned zeolites, and permits higher flow rates per square foot of area.

The softened water produced contains practically no hardness—only 0 to 2 parts per million of hardness expressed as calcium carbonate (ppm. as $CaCO_3$) by the most rigid tests.

Since the usual municipal water softener is not intended to produce a treated water of lower hardness than 3 to 5 grains per gallon or 51 to 85 ppm. (expressed as $CaCO_3$), it is necessary to mix some of the hard unsoftened water with the effluent of the zeolite plant. This is done by by-passing some hard water around the zeolite plant and controlling the by-passed stream so that it is always in proportion to the softened stream. In that way, the final mixed effluent will have a constant hardness at any particular figure desired.

If the raw water contains iron or other impurities, it may be necessary to remove these impurities by suitable equipment located on the by-passed pipe.

COMPARISON OF LIME-SODA AND ZEOLITE METHODS

There are certain conditions which favor the lime-soda method, and other conditions which favor the zeolite method. A municipality, before deciding on which of these two methods to install in any given case, must compare the advantages and disadvantages of the two methods by making a thorough study of the investment and operating cost, space required, ease of operation, etc. before coming to the final decision.

Advantages of the Lime-Soda Method

1) The use of lime for removing bicarbonate hardness is usually less expensive than the use of salt to regenerate sodium zeolite softeners. Therefore, if a water is high in bicarbonate hardness, the operating cost for lime treatment will be less than for zeolite.

2) If the raw water is turbid and needs clarification in addition to softening, the lime-soda method is less expensive to install because it combines water softening and clarification. On the other hand, a clarification plant must be installed to precede the zeolite plant.

3) If the raw water is polluted, the lime-soda method will aid in sterilizing the water, provided a sufficient time is allowed and the pH value is maintained high enough. The zeolite method does not sterilize the water and would require chlorination for the sterilization. Even in a case of lime-soda municipal water softener, reliance is not placed on the sterilizing effect of the high pH value alone, but in addition chlorinators are employed. The use of the sludge blanket type of lima-soda plant not only helps sterilization by virtue of the high pH value, but the sludge has coagulation and bacterial absorption effects.

Certain boards of health in the United States have required at least 4 hours in lima-soda plants to insure sterilization by the high pH value. This may be necessary for the old-fashioned settling tank where the sludge settles out, but with the modern sludge-contact reactor, the bacterial absorptive power of the suspended sludge lessens the number of hours' retention required.

4) The use of lime to remove bicarbonate hardness, as per the chemical reactions given above, precipitates this hardness, removing it from the water without substituting any other salts in its place. The alkalinity of the original water is, therefore, reduced by the amount of bicarbonate hardness eliminated. This reduction in alkalinity is not accomplished by the sodium zeolite process, because in that process sodium bicarbonate in the soft water is substituted for the calcium and magnesium bicarbonates present in the raw water. The alkalinity in the zeolite treated water is the same as in the raw water.

If the alkalinity of the water is high, its reduction is desirable for many purposes, particularly industrial application, such as for textile plants and boiler plants, etc.

Advantages of the Zeolite Process

1) The zeolite process can be carried out under pressure by passing the water from the raw water pump directly through a pressure zeolite softener to service. This avoids repumping. Repumping is usually necessary with lime-soda plants.

2) The space required by the zeolite plant is usually much less than for lime-soda.

3) If the water is high in noncarbonate hardness, the cost of the salt to regenerate the zeolite is usually less than the cost of soda ash in the lime-soda process. For this reason, in some cases, a combination of lime pre-treatment followed by zeolite has been used. This was true of the latest large municipal water softening plant installed, near Los Angeles, California.

4) The handling of salt, dissolving it in a saturated brine in underground wet salt storage basins, is much less troublesome than the storage of lime and soda ash and their handling.

5) The lime-soda process produces precipitates which have to be settled out and finally disposed of. If there is a very large river alongside, the precipitates or sludge may be discharged into this river without difficulty. Usually, however, objections arise even in the case of fairly large rivers, because the sludge settles out to the bottom of the river and, later, during a rainy season, high velocities in the river stir up the settled sludge and carry it downstream, where it may cause complaints from users of the river. In many cases there is no good sized river to receive sludge. The practice then is to collect the sludge in lagoons where it is allowed to dry out in the sun and it is then hauled away. This is a very troublesome operation and it is unsightly. Some work has been done in the last few years to dry the sludge and calcine it to make lime out of it again. This involves keeping the magnesium precipitates separate from the calcium precipitates. It also involves a considerable investment in the lime reclamation equipment. Furthermore, an excess of lime is produced by this reclamation, which has to be disposed of by sale to others.

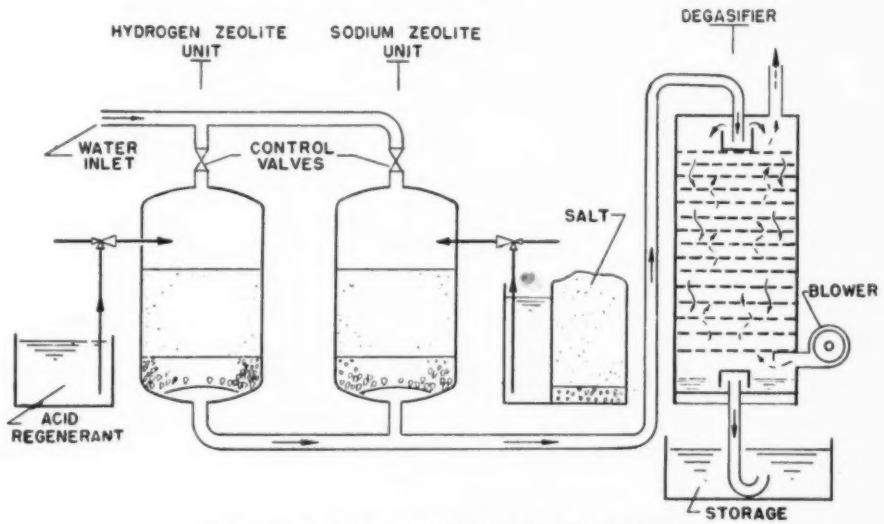


Fig. 5. Hydrogen and Sodium Zeolite Plant.

The zeolite process is free from these difficulties because no precipitates are formed and the waste liquors, during regeneration, contain calcium and magnesium chlorides which are very soluble and flow readily into the sewer system.

6) The zeolite softeners are usually easier to operate, requiring less skill in their handling than lime-soda softeners.

7) The zeolite process does not add any objectionable excess of reagent to the water, which may occur with the lime-soda softener if there is any negligence in handling of the lime-soda softener. In the case of lime-soda, too much lime, or too much

soda-ash, may render the water too high in pH value.

8) The zeolite treated water is stable and does not tend to after-react. The lime-soda treated effluent is not *completely* stable even after the use of sludge-contact reactors and carbonation or other means of reducing the pH value, which are frequently employed after the lime-soda plant to increase the stability of the treated water.

9) The zeolite plant, when operated under pressure, handling a well water free from dissolved oxygen, can produce a non-corrosive effluent because there will be no dissolved oxygen in the treated effluent. This assumes that there will be no exposure of the treated water to the atmosphere.

Where oxygen is picked up, however, or where the raw water contains oxygen, the zeolite treated water may not be noncorrosive, and alkali such as sodium silicate or soda-ash may have to be added to raise the pH value so that there will be a tendency for a slight precipitation to occur in the city distribution system. This precipitation provides a protective film on the inside of the pipe to prevent corrosion due to dissolved oxygen and carbon dioxide. The Lime-Soda Process, as stated previously, provides a treated water of high pH value, which tends to after-react and form deposits in the distribution system. It is, therefore, less likely to cause corrosion and, in fact, the excessive pH value present must be reduced to control the amount of such after deposits formed.

Fig. 6. Two Step Demineralizing Plant.

Future Developments

In addition to sodium zeolite, there are now available two other methods, namely, Hydrogen Zeolite and Demineralizing. These have not yet been applied for municipal purposes, but they have made great progress in the industrial field. The time is undoubtedly approaching when they will receive application for the removal of hardness as well as other dissolved impurities. The hydrogen zeolite is regenerated with acid instead of salt. It removes alkalinity as well as hardness. It, therefore, removes the objection to sodium zeolite previously mentioned. It will find application where acid is cheap and where lime may not be so cheap. It will particularly be preferred where the problem of sludge disposal with the lime-soda plant would be insuperable, and yet where it is desired that the alkalinity be reduced. Figure 5 shows a typical hydrogen and sodium zeolite plant.

Demineralizing is a two-step process. The water first passes through a hydrogen zeolite unit and then passes through an anion exchange unit. The first unit transforms all the salts into their corresponding acids. The second unit absorbs these acids and produces a water practically free from electrolytes. Figure 6 shows a typical demineralizing plant. In that respect, it is the equivalent of distilled water. For highly mineralized raw waters, demineralizing may find application in the future, not to produce distilled water, which is not needed for municipal practice, but to reduce the sulfates and chlorides to a partial extent and thereby improve a raw water for irrigation and other similar purposes. Sulfates and chlorides are not removable by either the lime-soda or the zeolite processes.

As the demand for higher quality of treated water rises, these newer processes of hydrogen zeolite and demineralizing will, undoubtedly, take their place in municipal water treating practices.

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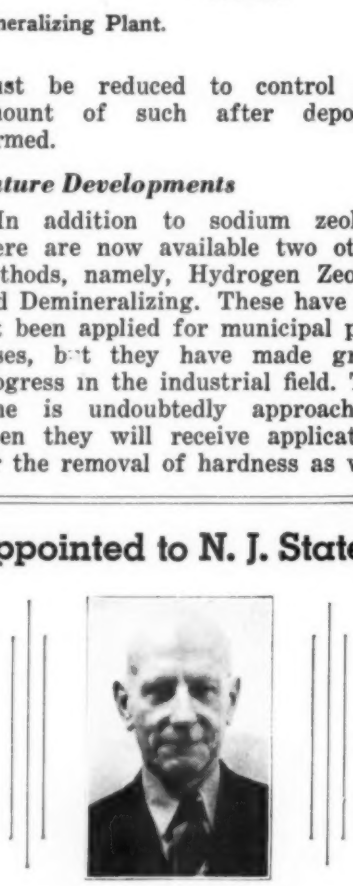
Harry Lendall Appointed to N. J. State Board of Health

Harry N. Lendall, C.E., Chairman of the Dept. of Civil Engineering and Professor of Municipal and Sanitary Engineering at Rutgers University, was appointed to the New Jersey State Board of Health in September. A native of Massachusetts and a graduate of Tufts College, where he received the degree of Bachelor of Science in Civil Engineering in 1906 and the degree of Civil Engineer in 1926, Professor Lendall has been on the faculty of the College of Engineering, Rutgers University, since 1912.



In addition to his university work, Professor Lendall, in association with other engineers and as a private consultant, has had very considerable experience in engineering practice both in the construction of sewage systems, sewage disposal plants, and in water supply systems. In addition, Professor Lendall was responsible for the organization of short courses for water and sewage plant operators first offered in 1927 by Rutgers University. He was also Secy.-Treas. of the N. J. Section of AWWA, 1938-39, Trustee, 1940-44, Chairman of several committees, and Director from the New Jersey Section, 1941-44. His most recent honor was the nomination for the Fuller Award by the New Jersey Section at its recent 1946 meeting.

HYDRAULICS FOR THE PRACTICAL WATER WORKS MAN

The Fifth of a Series of Articles

Intakes and Pressure Losses in Pipes; the Effects of Age on Pipes

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IN THE previous installment the method of calculating friction losses in pipe lines was explained and the necessary data given. To illustrate the application of the method, suppose that an intake pipe (Fig. 19) 2000 ft. long is laid from a pump well out into a lake and that it is desired to have the water in the well not over four feet below lake level under a demand of 2,400,000 U. S. gallons per day. The pipe is to have a smooth interior finish similar to that of coated cast iron pipe, and is to have a bell mouth entrance in which the loss is negligible, and further, there are no bends except the one shown at the end. What size pipe should be used?

The four feet difference in levels is simply the friction loss in the pipe (see Figs. 5 and 9) and a study of Fig. 18 would make it appear that a 16 in. pipe might be examined as a first trial. If this is the correct size, the velocity in it will be 2.66 ft. per sec. (from Table I of earlier installment) and the corresponding velocity head will be 0.11 ft. from Fig. 12. Further, since the entrance loss is negligible, the only losses will be those due to the straight pipe and the elbow, to which must be added, however, the exit loss at the well end. The friction factor is 0:0211 (Table II of earlier installment) and the elbow causes the same loss as 10 ft. of pipe, while the loss at the well end is the same as that in 40 ft. of pipe. The total loss will therefore be

$$F = .0211 \times \frac{2050}{16/12} \times .11 = 3.6 \text{ ft.}$$

which indicates that 16 in. pipe would be the right size.

The Author

Effect of Age on Pipe

It must be kept in mind that as the pipe gets older the friction rises, and in unfavorable cases may easily increase 50 per cent, which would bring the loss up to 5.4 ft., and if such a drop in well level is objectionable it would be better to install a larger pipe to begin with. Loss of head in an intake is usually not very serious from the power standpoint, but it produces a higher suction lift on the pump, which is often objectionable, especially if there is danger of the lake level lowering with time. If instead of the 16 in. pipe one 18 in. is used, the loss of head in the pipe when old would only be 3.1 ft.

Pressure Required for Pumping

Now suppose a single pump is used on this job and that it has a 10 in. suction pipe arranged as shown on Fig. 19, what would be the reading on the suction gage, corrected to the center line of the pipe? It is assumed that there is no foot valve or strainer, priming being separately arranged. For the 10 in. pipe delivering 2,400,000 gallons per day the velocity is 6.8 ft. per sec., for which Fig. 12 gives the velocity head as 0.72 ft., while Table II gives the friction factor as 0.22. If the length of straight pipe is 30 ft. and 10 ft. are added for the elbow (Table III of earlier installment) the equivalent length of straight pipe is 40 ft., in which the friction loss is

$$F = .022 \times \frac{40}{10/12} \times .72 = 0.76 \text{ ft.}$$

or practically 0.8 ft. (This may be checked on Fig. 18.) Applying the method described in the third article of this series shows that the gage will indicate a vacuum of 3.6 + 6.0 + .72 + .80 or 11.1 ft., which is not too high for a centrifugal pump.

In the last example consideration should be given to the fact that when the suction pipe is old and the intake also, this lift will be increased to around 13.3 ft., which is fairly high and will prove troublesome if increased by a drop in lake level. The pump should be set as low as possible, preferably below lake level, which offers the additional advantage of freedom from the necessity of priming.

Discharge Pressure at the Pump

Now let us suppose that the pump is delivering its full capacity through 4,000 ft. of 12 in. pipe that has been in service for about ten years and is a little corroded but is still in fair condition. There are eight right-angle bends and four full open gate valves in the line and it delivers water to a reservoir 180 ft. above the lake. What pressure would the gage

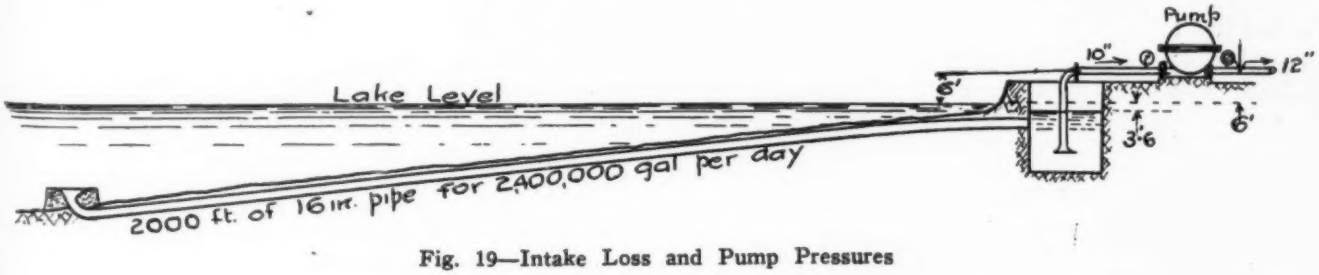

Fig. 19—Intake Loss and Pump Pressures

on the discharge pipe, near the pump, show?

For this case the velocity in the pipe is 4.72 ft. per sec. (Table I), and the velocity head is 0.35 ft. from Fig. 12. Further, the friction factor of 0.0213 (given in Table II), must be increased by about 25 per cent on account of the old pipe and then becomes 0.0266, and since there are eight bends, each of which has the same loss as 10 ft. of pipe, the equivalent length of straight pipe is 4,080 ft. The four gate valves each give a loss equal to 0.06 of the velocity head, making a total for these of $4 \times .06 \times .35$, or approximately 0.1 ft. The loss of head in this line is then

$$.0266 \times \frac{4080}{12/12} \times .35 + .10 = 38.1 \text{ ft.}$$

(This could have been taken from Fig. 18 by adding 25 per cent to the values given there.) We must finally add the velocity head 0.35 ft. (Table III) to allow for exit loss, bringing the loss to 38.5 ft.

Proceeding by the method described in the third article, which says that the sum of the elevation head, the pressure head and the velocity head at the gage must equal the elevation head plus the pressure head of a pound of water in the reservoir (where the velocity is zero), plus the loss of head in friction between the gage and the reservoir, we have the following relation, elevations being based on the lake level as datum: $6 + p + .35 = 180 + 38.5$, or the pressure p on the gage is 212.1 ft. The power delivered by the pump to the water is, of course, due to the difference in pressures of the suction and discharge gages (since both are at the same level), plus the difference between the suction and discharge velocity heads. The difference in pressures (added since the suction gage has a negative or vacuum reading) is $212.1 + 11.1 = 223.2$ ft., while the difference of velocity heads is $0.35 - 0.72$ or minus 0.37 ft., making a total head of 222.8 ft. to be pumped against. Note that the velocity head difference is a negative one since that in the suction pipe is the greater of the two.

The pump must, therefore, deliver 2,400,000 gal. per day, or 1,667 gal. per min., against 222.8 ft. head, and since a gallon weighs 8.33 lbs., this requires a water horsepower of $1,667 \times 8.33 \times 222.8/33,000 = 93.8$ H. P. If the pump is of high grade, it should have an efficiency of at least 80 per cent and the motor would need to be $93.8/0.8 = 118$ H. P., the nearest commercial size to which might be 125 H. P.

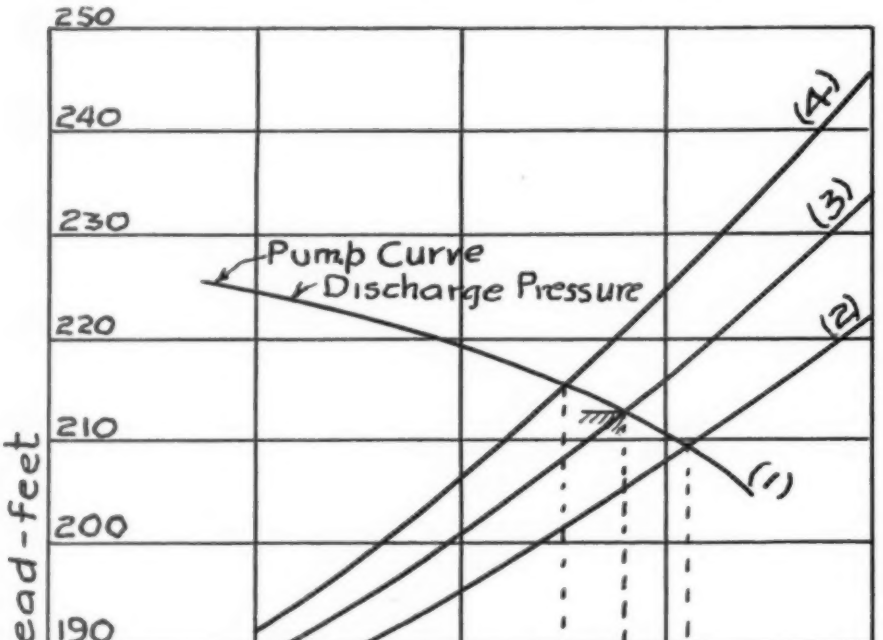

Fig. 20—Effects of Age of Pipe on Pump Delivery
(Curve 2 applies to new pipe; curve 3 to pipes where friction has increased 25%; curve 4 to pipes where friction has increased 50% due to age.)

Effect of Roughening of Inside of Pipe Due to Age

Here again deterioration of the inside condition of the pipe must not be forgotten, for it means a decrease in carrying capacity for a given pump pressure. But all centrifugal pumps, when working near their maximum efficiency point, show a decrease in discharge as the pressure rises, and it will be of interest to examine the matter further. An interesting study of this problem is illustrated in Fig. 20, where a typical head-discharge curve (1) for a centrifugal pump is shown, the pressures plotted being those on the discharge gage. The pressure necessary to force different quantities of water through the discharge pipe is shown on the curves (2), (3) and (4), these latter curves being found by calculating, in the manner already described, the pressures for a number of discharges and in each case for the estimated friction factor corresponding to the age of the pipe. Curve (2) is for new pipe, while (3) and (4) correspond to increases of 25 per cent and 50 per cent, respectively, in the friction. These curves may, of course, be plotted by using Fig. 18 of the previous article.

In the diagram the pump is assumed to give its rated capacity of 2,400,000 gals. per day where the pipe is as described above, and Fig. 20 shows that the discharge will fall to 2,250,000 gal. per day for 50 per cent increase in friction above new pipe and that it was 2,550,000 gal. per day when the pipe was new. Unless provision is made to counteract it this loss may be serious, because the demand usually *increases* as time goes on.

Branched Pipes

In cases like that just discussed relief is often sought by putting in a new pipe and this problem will now be considered. As the first case, let us suppose that on a line of old 10 in. horizontal pipe two gages attached at points 2,000 ft. apart show a pressure drop of 20 ft., and if the pipe had been new, this would correspond to a discharge of 1,210 gal. per min., as is easily calculated or may be read from Fig. 18. But when the pipe is old and rusted, the friction factor might increase 50 per cent in unfavorable cases, and if it did, the discharge would fall to 973 gal. per min. for the same pressure drop of 20 ft.

In order to compensate for this decreased discharge without disturbing the gage pressure difference of 20 ft., let us suppose that a piece of new

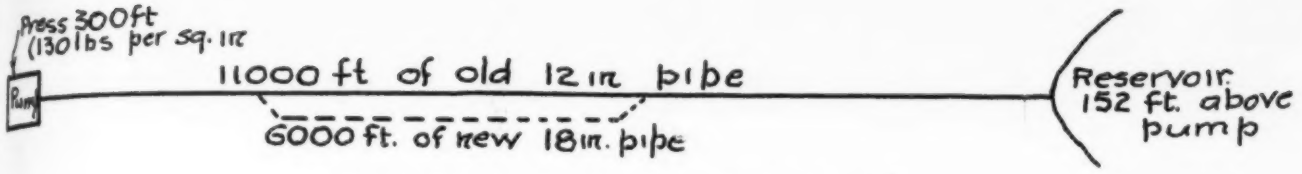

Fig. 21—Branched Pipe and Pump Pressure of 300 ft.

12 in. pipe is laid in parallel with the 2,000 ft. of old pipe and that the new pipe is joined at both ends to the old one by Y branches and 45 deg. bends, which offer very little hydraulic resistance. What will be the flow for both pipes if the gage readings are unchanged? The first impression is that the water will divide between the two pipes in proportion to their areas, but this is wrong, and a little consideration will show that the division of flow is such that the loss of head in each of the pipes will be 20 ft. By use of Fig. 18 it is shown that this will correspond to a velocity of 5.55 ft. per sec. in the new piece, so that this pipe will carry 1,960 gal. per min. For the old piece the discharge will continue at 973 gal. per min., so that the two combined will deliver 2,933 gal. per min. between the two points, which is more than double what it was before.

Effect of a Branch on a Long Pipe

As a useful practical application let us examine the case illustrated in Fig. 21, where a pump has been discharging through 11,000 ft. of old 12 in. pipe to a reservoir, and the flow has diminished so much that it must be augmented. The reservoir is 152 ft. above the pump, and we shall suppose that the pressure at the pump can be maintained at 300 ft. or 130 lbs. per sq. in., so that the friction loss in the line is $300 - 152 = 148$ ft. This loss of head corresponds to a velocity flow of 6.5 ft. per sec. (see Fig. 18) or to 2,300 gal. per min. for new pipe of these dimensions. If desired this may be checked by the formula

$$F = f \frac{l}{d} \times \frac{V^2}{64.3}$$

in which F is 148 ft., l is 11,000 ft., f is 0.0206 (Table II), and d is one foot, and from these the velocity will be found to be 6.5 ft. per sec. as before.

Increased friction as the pipe becomes older will decrease this flow to a point where we shall assume it must be improved. The pipe might be removed and replaced by a new one, but this is rarely done, for obvious reasons, and a common practice is to lay a new pipe in parallel with the old one, to which it is joined at several points. It would be best to lay the new pipe all the way from the pump to the reservoir, but it very often happens that there is not enough available money for this and the work is often done piece by piece till it is complete.

Suppose that in this case after the pipe has been in service so long that the friction loss has increased 50 per cent for a given flow and a piece of new 18 in. pipe 6,000 ft. long is laid in parallel with the same length of old pipe, to which it is joined at its two ends by Y connections as shown by the dotted line on Fig. 21, what improvement might be expected from this addition? For simplicity in this problem the pressure at the pumphouse is assumed to remain at 300 ft. and the pipe is taken as free from bends and other obstructions, and the loss at the junction points will be taken as negligible compared with the line losses.

This problem is not difficult but requires some thought because of the difficulty of seeing how the water divides at the branch between the old and new pipes, but the former example will prove helpful. In this case the new pipe will greatly increase the capacity of the system, partly because it is new and partly because of its size; in fact, this new piece will considerably reduce the loss between the points it connects. There are various ways of examining the effect of this new pipe, but perhaps the one which will most appeal to the readers of these articles is the old established one of trial and error, a process much shortened by some expeience but which can be successfully used by anyone with a little patience.

Of the total loss of 148 ft., a relatively small part will be in the branched section, just as in an alternative route between two cities the time required for a car to travel is much reduced by the two roads that are available. As a first trial we shall suppose that the loss of head in the branched section is 12 ft., then for the 6,000 ft. of new 18 in. with friction factor 0.021 we would have

$$F = 12 = .021 \times \frac{6000}{1.5} \times \frac{V^2}{64.3}$$

from which the velocity will be found to be $v = 3.03$ ft. per sec., corresponding to 2,410 gal. per min. Similarly for the old 12 in. part of the pipe the friction factor is 0:035 (the tabular value increased 50 per cent), and F is 12 ft. as before, from which the calculated velocity in the 12 in. pipe will be found to be 1.92 ft. per sec., and this corresponds to a flow of 678 gal. per min. in the 12 in. pipe.

Now if our assumption of 12 ft. loss in the branched section is right, the 5,000 ft. of single old 12 in. line must carry $2,410 + 678$ gal. per min. with a loss of head of $148 - 12 = 136$ ft., since the total loss in the system is to be 148 ft. But the discharge just given means a velocity of 9.28 ft. per sec., whereas the loss of head of 136 ft. will occur if the velocity is only 7.51 ft. per sec. as calculated from the relation

$$F = f \frac{l}{d} \times \frac{V^2}{64.3}$$

If desired, the curves of losses in pipes of Fig. 18 may be used. It is evident that the branched section lets through more water than the single part of the system can handle, and therefore our assumed loss of 12 ft. in the branch is too high and we must try a lower value.

The following table reveals the results of four trials.

Branched Section 6000 ft. long				Single Section 5000 ft. long	
Loss of Head, ft.	Discharge, gal. per min. 18 in. pipe	12 in. pipe	Total gal. per min.	Loss of Head, ft.	Discharge, gal. per min.
12	2410	678	3088	136	2650
11	2300	648	2948	137	2660
10	2190	617	2807	138	2670
9	2080	586	2666	139	2680

Evidently the loss in the branched section is practically 9 ft. and the capacity of the system is about 2,680 gal. per min. as compared with a discharge of 2,300 gal. per min. in the original new 12 in. pipe. The small proportionate loss of only about six per cent of the total in the branched section gives ample evidence that the branch should be extended as soon as possible.

(Additional installments will follow.)

A PLEA FOR SOUND ECONOMY IN STREAM POLLUTION ABATEMENT*

Some Thoughts on Policy and Practices in Tackling the Stream Pollution Problem

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ATTENTION is called to some of the important economic factors involved in the stream pollution abatement program. In discussing this phase of the problem, certain fundamental facts must be considered, namely:

1. There is a real need for pollution abatement along many of our streams or sections of such streams. This seems undebatable.

2. The public wants pollution of our streams controlled. The people have so expressed themselves through their legislators and the establishment of laws to control pollution.

3. The United States Public Health Service estimates that the probable tangible annual damage to the streams in the United States by pollution amounts to at least $100,000,000.

4. There can also be other economic benefits deriving from a *sound* pollution abatement program. For instance, natural resources can be conserved where it is possible to recover usable materials from the wastes instead of merely attempting to treat existing wastes for discharge to the streams.

5. On the other hand, the cost of new constructoin to properly dispose of the domestic and industrial wastes of the country has been conservatively estimated at approximately $3,000,000,000. To operate and maintain these treatment plants and to liquidate the cost of construction would cost several hundred million dollars per year.

6. The general public ultimately will have to absorb this cost in the form of taxes or increased cost of consumer goods, or both.

It appears, therefore, that the problem resolves itself into deriving as many of the benefits as are necessary or possible and, at the same time, keep the investment cost for treatment plants to a minimum. In other words, the maximum benefits should be derived for the minimum cost through a combination of material or product recovery and the resultant minimum of ultimate treatment.

There are certain minimum conditions of water quality in the streams that are acceptable. For instance, the general public will not tolerate conditions that cause nuisances or cause the streams to have an obnoxious appearance. Therefore, the minimum acceptable treatment, in most cases, will probably be treatment to remove materials which cause obnoxious odors or appearance, or the presence of floating solids, scum, oily sleek, or the formation of sizable bottom deposits or sludge banks.

Sound Economy of Paramount Importance to Ultimate Success

In order to keep the cost of any additional treatment to a minimum, it is believed that it will be necessary for all concerned with any particular pollution problem to get together and work out the most economical solution to the problem. By "all concerned" is meant the polluters, those affected by the pollution and the governmental agencies involved. In meetings of such a group, the problem *in its entirety* can be discussed in its relation to the individual problems. Everyone will then have a better understanding of the problem and what will be expected of him in the way of pollution abatement. The relative weights to be given to each type of use of the water in the streams can be discussed and the whole problem can be worked out to keep the cost of treatment to a minimum and the economics on a sound basis.

With any particular pollution problem what can be accomplished by cooperation of all concerned can be illustrated by the following examples.

Suppose a municipality or industry is located above a water works intake and discharges wastes into the stream that necessitates the abnormal use of chemicals by the water works in order to purify the water. It may be found that this extra cost for chemicals is small compared to what it would cost to treat the wastes to the extent that it would not to some extent affect the chemical requirements at the water purification plant. Or it may be found that by eliminating some particular waste or by treating some portion of the waste that the difficulty would be alleviated.

In another case, it may appear that treatment of a waste will be required, under existing conditions, due to the fact that only a portion of the diluting effect of the water in the stream is being utilized before the water arrives at the point of another use. It may be found possible to reduce the amount of treatment necessary or eliminate the necessity of treatment entirely by diverting or more effectively dispersing the waste discharged.

In some cases it may be found that an industry can recover currently wasted usable materials economically (or at slight overall cost) and materially reduce or eliminate the necessity of treating the ultimate waste from a given process or the plant as a whole.

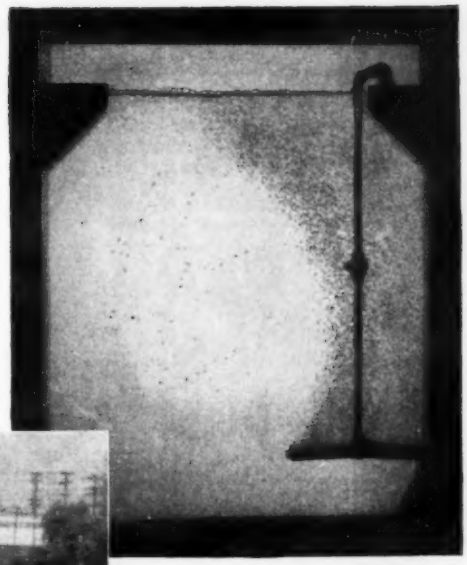
Also, on streams where the flows are controlled by reservoirs, it may be found possible to increase the flow of these streams during low water periods and thereby materially reduce the degree of waste treatment necessary.

Too much stress cannot be placed on solving the stream pollution problem economically. In studying each individual pollution problem, the economic considerations should be emphasized if the program is to be practical and supportable on a sound and healthy basis on a national scope.

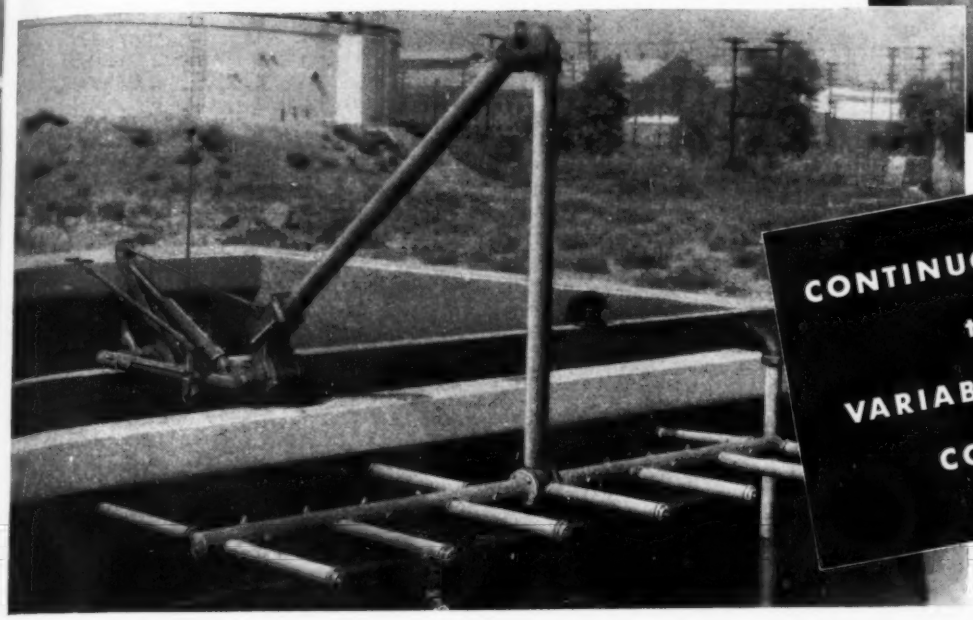
*A statement prepared at our request, and comprising certain considerations in pollution abatement emphasized by the author in a pointed impromptu discussion before the Kentucky-Tennessee Section of A.W.W.A.—Editor.

CHICAGO WIDE BAND TRADE MARK*

SWING DIFFUSERS*



Scale model Swing Diffuser in operation showing the Chicago Wide Band Air Diffusion System.



CONTINUOUS AERATION to meet VARIABLE OPERATING CONDITIONS

Swing Diffuser at the East Chicago, Indiana, Sewage Treatment plant.

OVER 100 SUCCESSFUL INSTALLATIONS

EFFICIENCY: Chicago Wide Band Air Diffusion System provides greater oxygen absorption — eliminates center coring—requires less air for optimum circulation—effects power economy through reduced hydrostatic head on elevated diffuser tubes.

FLEXIBILITY: Swing Diffusers can be raised to the tank walk for cleaning tubes and for simple rearrangement of diffuser tube spacing to conform with oxygen demand without de-watering tank or interrupting operation.

*Patented

NOTABLE, EXCLUSIVE CONTRIBUTIONS TO SEWAGE TREATMENT

"PACKAGE" PLANTS
SWING DIFFUSERS
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CHICAGO PUMP COMPANY

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Flush Kleen, Scru-Peller, Plunger, Horizontal and Vertical Non-Clogs, Water Seal Pumping Units, Samplers.

Swing Diffusers, Stationary Diffusers, Mechanical Aerators, Combination Aerator-Clarifiers, Comminutors.

MEETINGS SCHEDULED

Dec. 19—BOSTON, MASS. (Hotel Statler)
New England Water Works Association. Sec'y-Treas., Jos. C. Knox, 609 Statler Bldg., Boston, Mass.

Jan. 6-8, 1947—PITTSBURGH, PA. (Wm. Penn Hotel)
Engineers' Society of Western Penna. Chairman, H. M. Olson, 171 Longue Vue Drive, Mt. Lebanon, Pittsb'g, Pa.

Jan. 13-18—NEW YORK, N. Y. (Commodore Hotel)
American Society of Civil Engineers. Sec'y-Treas., Wm. N. Carey, 33 West 39th St., New York, N. Y.
(Sanitary Engrg. Div., Jan. 15 [P.M.], Jan. 16 [A.M.].)

Jan. 17—NEW YORK, N. Y. (Hudson Hotel)
New York State Sewage Works Association. (Annual Meeting.) Sec'y-Treas., A. F. Dappert, State Board of Health, Albany, N. Y.

Jan. 17—NEW YORK, N. Y. (Commodore Hotel)
New York Section A.W.W.A. Mid-Winter Luncheon Meeting.) Sec'y-Treas., R. K. Blanchard, 50 West 50th St., New York, N. Y.

Feb. 19—NEW BRUNSWICK, N. J. (Hotel Roger Smith)
New Jersey Section A.W.W.A. (Luncheon and Afternoon Program.) Sec'y, C. B. Tygert, Box 178, Newark, N. J.

Feb. 23-25—ST. LOUIS, MO. (Statler Hotel)
American Concrete Pipe Association. (National Convention.) Director, Howard F. Peckworth, 228 N. LaSalle St., Chicago, Ill.

Mar. 13-15—ST. PAUL, MINN. (Lowry Hotel)
Minnesota Section A.W.W.A. Sec'y-Treas., R. M. Finch, 416 Flour Exchange Bldg., Minneapolis, Minn.

Mar. 19-21—TRENTON, N. J. (Stacy-Trent Hotel)
New Jersey Section A.W.W.A. Sec'y-Treas., M. S. Kachorsky, P. O. Box 283, Manville, N. J.

Apr. 7-10—CHICAGO, ILL. (Palmer House)
The National Ass'n of Corrosion Engineers. Exec.-Sec'y. A. B. Campbell, 711 Main St., Houston, Texas.

Apr. 10-11—BUFFALO, N. Y. (Statler Hotel)
New York Section A.W.W.A. (Spring Meeting.) Sec'y-Treas., R. K. Blanchard, 50 West 50th St., New York.

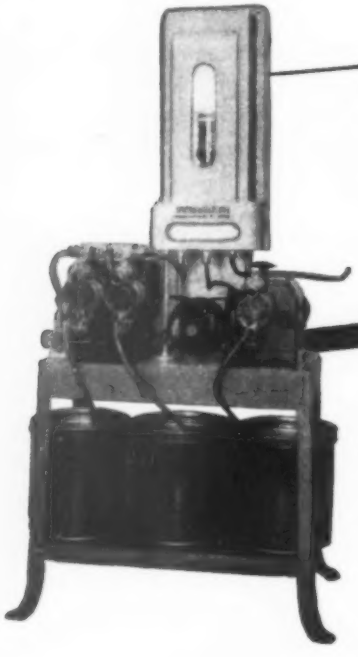
Apr. 17-18—CHICAGO, ILL. (Congress Hotel)
Illinois Section A.W.W.A. Sec'y-Treas., H. A. Tolburg, 2020 S. Fifth St., Springfield, Ill.

Apr. 25-26—HAVRE, MONTANA
Montana Section A.W.W.A. Sec'y, C. W. Brinck, State Board of Health, Helena, Mont.

July 21-25—SAN FRANCISCO, CALIF. (Auditorium)
American Water Works Association 1947 Conference. Executive-Secretary, Harry E. Jordan, 500 Fifth Ave., New York 18, N. Y.

July 22-24—SAN FRANCISCO, CALIF. (Auditorium)
Federation of Sewage Works Associations. (20th Annual Meeting.) Executive-Secretary, W. H. Wisely, 325 Illinois Bldg., Champaign, Ill.

(Meetings and Exhibits in the Auditorium. Application blanks for hotel accommodations will be mailed to members by the respective Association Headquarters about Feb. 1st, 1947.



TASTE AND ODOR REMOVAL FOR JAMESTOWN, RHODE ISLAND by MATHIESON'S CHLORINE DIOXIDE TREATMENT

JAMESTOWN WATER COMPANY, JAMESTOWN, R. I.

MR. ALLAN G. DAVENPORT, Manager of Jamestown Water Co., reports:*

1 Chlorine Dioxide eliminates taste and odors from water of swampy origin.

2 The treatment makes it possible to carry a sterilizing residual throughout the system without taste.

3 The hypochlorite, acid and sodium chlorite method of generating chlorine dioxide is simple and efficient and can be used efficiently by small and medium size water plants.

4 The proportioning pumps and accessory equipment required are lower in first cost and maintenance than equipment required for the gas chlorine method.

%Proportioneers% will be pleased to give you a recommendation and quotation on the new packaged set-up for chlorine dioxide treatment at your plant. Write today for details.

*Reprints of Mr. Davenport's article on his experiences with Chlorine Dioxide Treatment at Jamestown, R. I. may be obtained on request.

Complete package equipment for Mathieson Alkali Works' Chlorine Dioxide Treatment now available from %Proportioneers, Inc.%. Solutions of acid, hypochlorite and sodium chlorite are pumped by Duplex and Simplex Chem-O-Feeders into the plastic chlorine dioxide generator. A modern streamlined aluminum case with fluorescent illumination houses the generator. Equipment is complete as shown, ready to install.

Write for information.

% PROPORTIONEERS, INC. %

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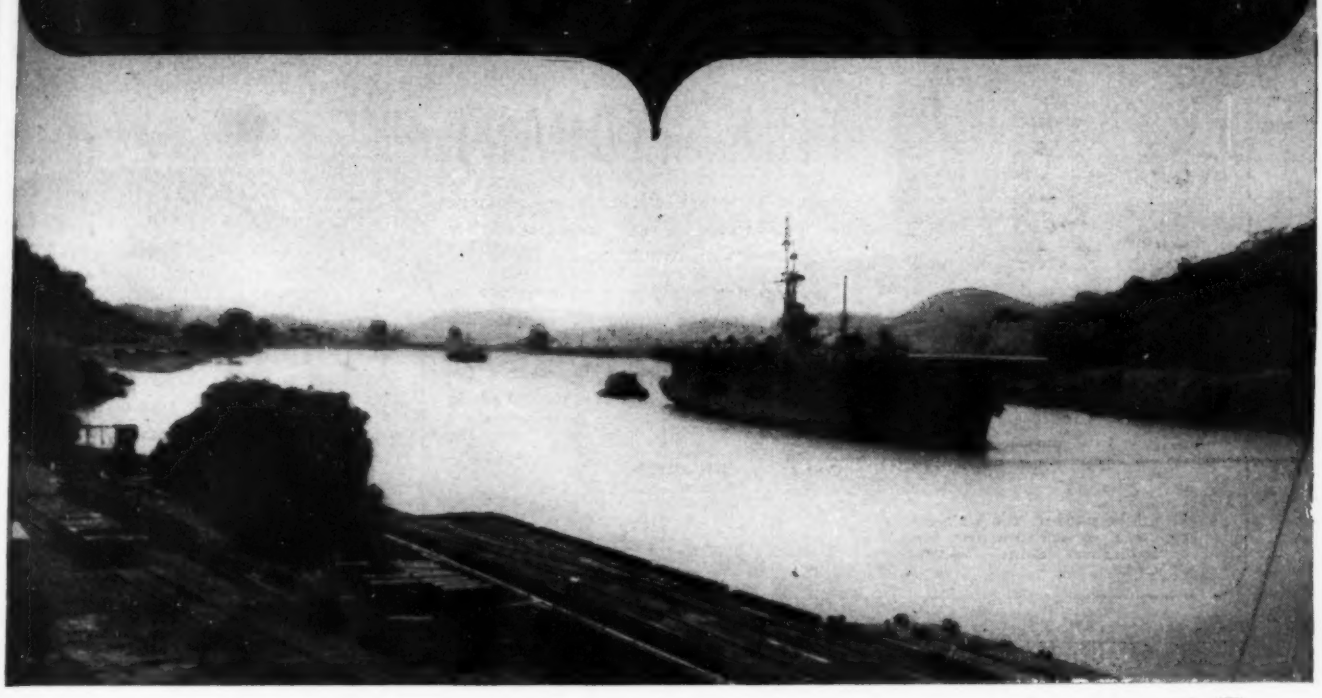
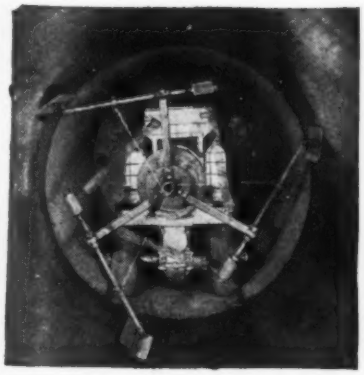
CENTRILINES



. . . **CENTRILINE** has recently reconditioned for the Government, the 58,000 feet of 30 and 36 inch cast-iron pipe line from Gamboa Pumping Station to Miraflores, Panama Canal Zone. The increased carrying capacity will now be permanently maintained by the thin, dense, smooth cement mortar lining centrifugally applied—a reliable guarantee against future tuberculation, underlying deterioration of metal and increased pumping costs.



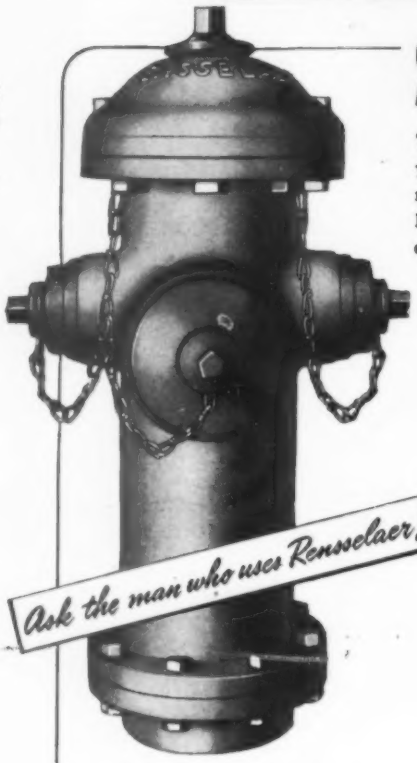
The Centriline process is a rapid, economical method of reconditioning pipe lines 30" and larger. After cleaning, a thoroughly premixed cement mortar lining of desired thickness is applied centrifugally without rebound. This dense quality product is mechanically trowelled to a smooth finish providing maximum carrying capacity which is permanently sustained. This work is performed underground, in place.

CENTRILINE CORPORATION

148 CEDAR STREET • NEW YORK 6, N. Y.

Restores and Protects Pipe-Line Carrying Capacity

RENSSELAER
FIELD SERVICE



Our Representatives are Anxious to Serve You!

These factory-trained men are at your service when and where you need them, on short notice. Warehouse stocks normally maintained at points throughout the U. S.

Defender

FIRE HYDRANT

Backed by years of faithful service, these hydrants have proved their superiority in hundreds of installations.

This superiority is based on constant research and application of engineering knowledge to actual field problems. The outstanding features of Rensselaer Defender Fire Hydrants are described in our bulletin.

Write for Bulletin W

Please be patient. The wide acceptance of our products has caused some delays in deliveries.

PROMPT ATTENTION by the Rensselaer factory is assured whether you write, wire or phone a large order or a simple inquiry.

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519 Farnsworth Bldg.

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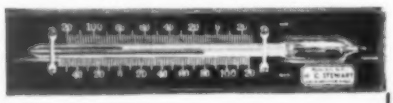
817 Braniff Bldg.

PITTSBURGH, PA.
2203 Oliver Bldg.

SAN FRANCISCO, CALIF.
115 Townsend St.

SEATTLE, WASH.
1252 First Ave., South

WACO, TEXAS
206 Franklin Ave.



MAXIMUM - MINIMUM
THERMOMETER

Outdoor, self-registering type. Shows lowest and highest air temperature for the day, also present temperature. 8" etched brass scale, improved horizontal mounting, very accurate, fully guaranteed. Price $10.00. Circular mailed on request.

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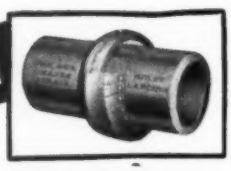


GASKET AND FORM
The Perfected Method for Making Sewer Pipe Joints of Cement

- No jute used—gasket centers spigot.
- Definite space in each joint for cement.
- Form confines cement-grout to lower portion of joint.
- Particularly advantageous in water-bearing trenches.
- Infiltration minimized.

L. A. WESTON Adams, Mass.

Here and There with Doc Symons

This is the announcement You Have Been Waiting For! It is not the announcement I promised last month, but it definitely *is* the announcement you've been waiting for. It should have a special flourish of trumpets—the 9th Edition of Standard Methods for the Examination of Water and Sewage is off the presses. By the time you read this column you should be able to obtain a copy. In case you've forgotten in the interim since the 8th Ed. in 1936, this is the book on how to analyze water and sewage—you know, the one published jointly by the American Public Health Assn. and the American Water Works Assn. with the part on Sewage Testing written by a special Committee of the Federation of Sewage Works Assns.

I can't get you a copy wholesale, but if you send your order to me, I'll see that it gets immediate attention —And if you want your copy autographed by the Editor,—just let me know.

* * *

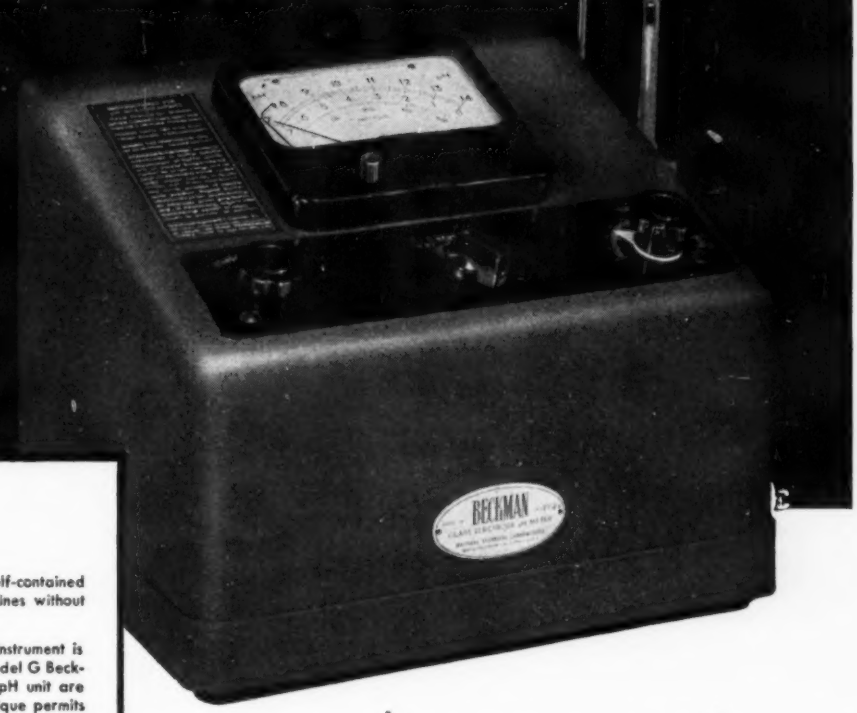
Out in Green Bay at the Wisc. Section Meeting this Fall, I had my camera trained on one Jimmy Meyers, Supt. of the Kenosha Water Works, when the announcement was made that he was chosen for the Fuller Award this year. Too bad my flash gun failed to go off at the proper moment because the look that Jimmy turned and gave to his gorgeous wife, Susy, was not only one of complete surprise but one that said, "Whatever I've done, you shared in." It would have made a good picture.

And while we're on that Wisc. meeting it seems fitting that the man who broke the registration record of the Wisconsin Section was Prof. Ernie Bear, State Geologist. There were a number of others after that, but it was Prof. Bear who was that important No. 255.

* * *

Another BECKMAN pH Advancement!

THE BECKMAN MODEL H PORTABLE AC pH METER



Full AC Operation: The Model H is completely self-contained and operates directly from standard 115 volt AC lines without accessory equipment of any kind.

High Accuracy: The accuracy of the Model H instrument is equivalent to that of the well known Model M and Model G Beckman pH Meters. For rapid work, accuracies of 0.1 pH unit are easily obtained, and more careful attention to technique permits determinations to 0.02 pH units. Such high accuracy has never before been available in a compact AC pH Meter.

Single-Point Buffer Calibrations: With the Beckman Model H it is not necessary to calibrate with two buffer solutions. The Model H incorporates a unique electronic circuit that permits accurate readings regardless of variations in resistance of the glass electrodes due to aging or due to electrode temperature changes after calibrations. This important advantage is accomplished without need for multiple buffer calibrations.

Maximum Temperature Stability: After a short warm-up period, subsequent change in calibration of the instrument due to temperature effects is very small—only about 0.1 pH unit in the first two hours and 0.05 unit subsequently. When maximum accuracy is required, this change may be instantly checked and corrected *without rechecking against buffer solution.*

Full Temperature Compensation, 0 to 100° C: A built-in temperature compensator covering the full range of 0° to 100° C can be set to compensate automatically the effect of temperature changes on the EMF of the glass electrode over the entire pH range of the instrument. Thus, the pH at the electrode temperature may be read directly from the dial without calculation or corrections.

Direct Millivolt Scale: The Model H Meter is graduated in millivolts as well as pH units, and a range switch permits measuring directly either in millivolts or pH at will.

Rugged Lightweight Construction: The Model H is housed in a cast aluminum case with an attractive dark gray wrinkle finish. The instrument weighs approximately 10 pounds, complete, and is easily carried. For maximum operating convenience the meter dial and all controls are mounted on a sloping panel.

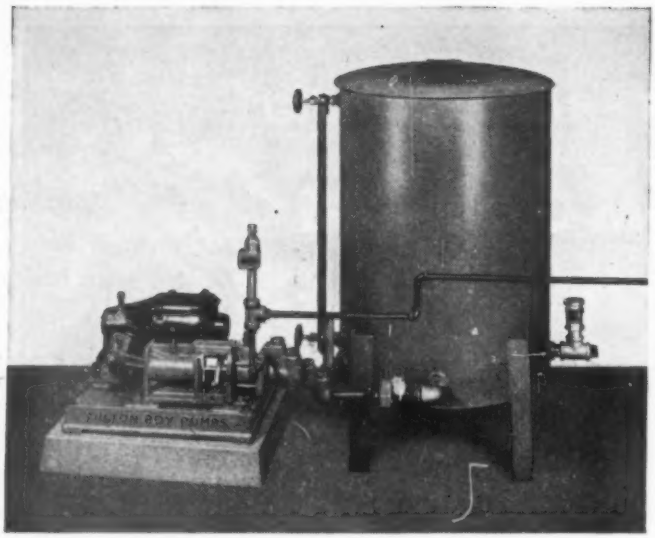
The First Portable AC pH Meter with DC Accuracy, Simplicity and Dependability

NO LONGER need you sacrifice accuracy and dependability to get the convenience of AC operation in a portable pH Meter. For now the same organization that pioneered modern glass electrode pH equipment, and has pioneered every major advancement in modern pH instrumentation and methods, brings another important development...a portable pH Meter that operates from standard AC current *without sacrificing any of the accuracy and dependability that are so essential in modern pH applications.*

This new instrument – the Beckman Model H pH Meter – has been in development over a long period of time. Many different designs and circuits were tested and rejected before an instrument was perfected that meets the rigid Beckman standards of excellence. The Model H Meter is not just an "AC" pH Meter. It is an instrument embodying advancements in circuit design that insure the same high operating efficiency and accuracy that have made Beckman pH Equipment standard throughout the world.

A few of the many unique features incorporated into the Beckman Model H pH Meter are outlined at right. Contact your nearest distributor of Beckman pH Instruments for further details...or write direct. *Beckman Instruments, National Technical Laboratories, South Pasadena 20, Calif.*

BECKMAN INSTRUMENTS CONTROL MODERN INDUSTRIES



MILTON ROY
CHEMICAL FEED SYSTEMS
for Boiler Water Treatments

Authorities agree two distinct methods are necessary for chemically treating boiler water. Sodium Sulfite should be fed into the suction side of the feed water pump . . . to remove dissolved oxygen, insure against corrosion and prevent pitting. Other treating chemicals, such as phosphates, soda ash and caustics cannot usually be fed in this manner. Individual chemical feed directly into each boiler is the approved method . . . to prevent scale formation, control alkalinity and prevent embrittlement.

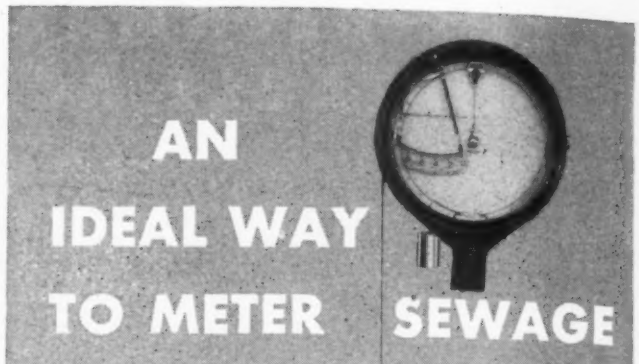
Milton Roy "Packaged Units" are available for both treating methods. For internal treating the unit includes heavy gage welded steel tank, gage glass, low level pump cut-out and alarm, together with necessary pump or pumps. For sulfite feed the unit includes 50 gal. 12 gage welded tank, gage glass, low level pump cut-out, bell alarm, doughnut float and one Milton Roy Pump with screw adjustment of stroke.

These "Packaged Units" are available also with electronic control, to continuously operate at a speed proportional to the rate of feed water flow as measured by a standard type flow meter. Fully automatic control is thus obtained, treatments are precisely as required, waste of chemicals is avoided.

For complete description of these systems, with specifications, diagrams, selection tables, etc., write for Bulletin 451. If interested in automatic controls, ask also for Bulletin 468.

MILTON Roy COMPANY
1377 E. MERMAID AVE., CHESTNUT HILL, PHILA. 18, PA.

Easy does it!



This non-fouling Parshall Flume and Foxboro Weir Meter system will answer any call for a simple, sure way to meter sewage.

It's easy to construct . . . easy to operate and maintain. Since it records continuously and directly in UNITS OF FLOW . . . there are no complicated figures to interpret – no chances of error. Furthermore it requires no costly purge system, no costly shut-downs for cleaning and no fussy maintenance of instruments.

The Foxboro Weir Meter is typical of Foxboro better-engineered instruments – rugged and reliable. Its flow measuring mechanism has a bakelite cam cut from a template ten times the size of the cam to assure tool-making precision. Its hardened stainless steel follower is designed to compensate for wear and maintain its accuracy.

OTHER FEATURES

1. **Micrometer zero adjustment on cable drum.**
2. **Positive protection against overrange.**
3. **Weatherproof and corrosion-resistant case.**
4. **Direct reading integrator—no complicated multipliers.**
5. **Equally as efficient with V-Notch or other Weirs.**

Get all the facts first before you plan a sewage metering system. Write for Bulletin A-298. **The Foxboro Company, 228 Neponset Ave., Foxboro, Mass., U. S. A.**

FOXBORO Reg. U. S. Pat. Off. **WEIR METERS**

Water Works Romances No. 3—I'll bet you didn't know that Hal Hutton of W & T met his wife (*very* charming, I might add) through Charlie Hoover, the Columbus Water Softening Man.

* * *

Associated Press, Please Note: At the Atlantic City Meeting of the N. J. Section of A. W. W. A. there was one of the usual Pee Bees Bridge Games. In that game were Ralph Tyler, Supt. Water, Camden, N. J., Charlie (De Laval) Coleman, Siggie (Nuchar) Sigworth, and that peerless consultant and authority on bridge (playing, not design), Mike Glace of Harrisburg, Pa. As the game progressed, one deck of cards was shuffled by Charlie Coleman; before being dealt it was cut by Mike, and it was then dealt by Sig. Mr. Sigworth bid a spade, Coleman bid two diamonds, Tyler bid four hearts, Glace bid five diamonds. Sigworth then doubled, Coleman passed, Tyler bid six hearts, and Glace passed. That ended the bidding—too bad, too, because Ralph Tyler held thirteen (count 'em, 13) hearts. Page the Associated Press.

* * *

Special Announcement No. 2: Last January in my column I predicted that during the year I'd come up with at least two new ideas for *W. & S. W.* Well! this is to announce that *one* of these new ideas is to be found in the annual index which will be issued as a separate leaflet and enclosed with the January copy of *W&SW*.

For a long time I've thought that one of the services that this magazine renders to its readers is to be found in the meeting reports which carry, in brief form, the essentials of the various papers that are presented at technical meetings around the country. These brief reports of the essence of the papers (abstracts in reality) often appear long before the complete paper is printed, and being short, save the busy reader much time in covering a wide variety of technical topics.

O. K., so these meeting reports serve a useful purpose. "But," you say, "at the end of the year if I want to look up some one of these reports to find out what was said about a certain subject, I don't know in which issue to look." Right you are, or rather right you were, for now all you have to do is to look in the annual index which you will receive along with the January issue. You will find there the topics discussed or presented in papers at all of the technical meetings which have been re-

Glauber

FACTORY-MADE LEAD GOOSENECKS FOR MAXIMUM FLEXIBILITY, EASY INSTALLATION AND LONG SERVICE

At Glauber you can secure flexible factory-made lead goosenecks with either single or multiple connections for easy installation of water service lines.

Regardless of water specification, these lead wipe joint goosenecks and red brass corporation stops are unsurpassed for providing maximum water flow and long service. K-1148 illustrated complete with corporation stop and solder nipple with outside iron pipe thread. Lead flange goosenecks and copper service pipe connections and stops are also available. Write today for quotations on your requirements.

THE **Glauber** BRASS MFG. CO.

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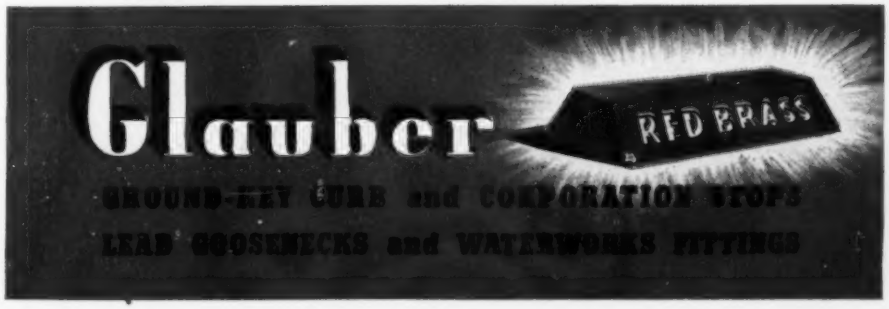
Division of H. B. Salter Mfg. Co., Marysville, Ohio



ported in this magazine during the current year.—How do you like the idea?

* * *

Did you ever eat snails? I thought I was going to in Toronto the last night of the Federation Meeting in October, but the Maison Doré was out of snails that night. I "kinda" think I'm glad, because I should have hated to disappoint our hosts of the evening, "Cap" and "Sally" Delaporte, two swell persons from Toronto. I say *our* hosts because Cap and Sally took the Enslows and yours truly to dinner that night, along with Ollie and Helen Ball. A very pleasant ending to a very pleasant convention in Canada. Hope I get back there again some day.—And how about you folks coming to visit us some time?

* * *

Some of my older readers who were reading this column way back in November 1943 may remember that I spent some considerable time in upbraiding persons who take too much time to present papers at technical meetings. I wanted to start a League for Limiting Long Winded Speakers, and then with some coyness I suggested that if anyone wanted me to appear on a program to tell how it should be done, I'd be glad to oblige.

This is to report that I finally had a taker on that offer.—The Erie County Chapter of the N. Y. State Professional Engineers' Society invited me to speak on the subject, "Us Engineers Don't Need No English," or how to write and present articles at technical meetings. It was an after-dinner speech, and what did I talk about?—About an hour. Now that I'm a professional after-dinner speaker, this is to let you know I'm available for barbecues, fish fries, coffee klatsches, picnics and breakfast at your house. Also baby sitting at reasonable prices.

* * *

Did I mention that at the N. E. W. W. A. Annual Meeting at Poland Spring this past Sept. the exhibits were confined to spaces around the meeting room and to the hallway approaching it? Not a bad idea; keeps the exhibits and the "attenders" together most of the time.

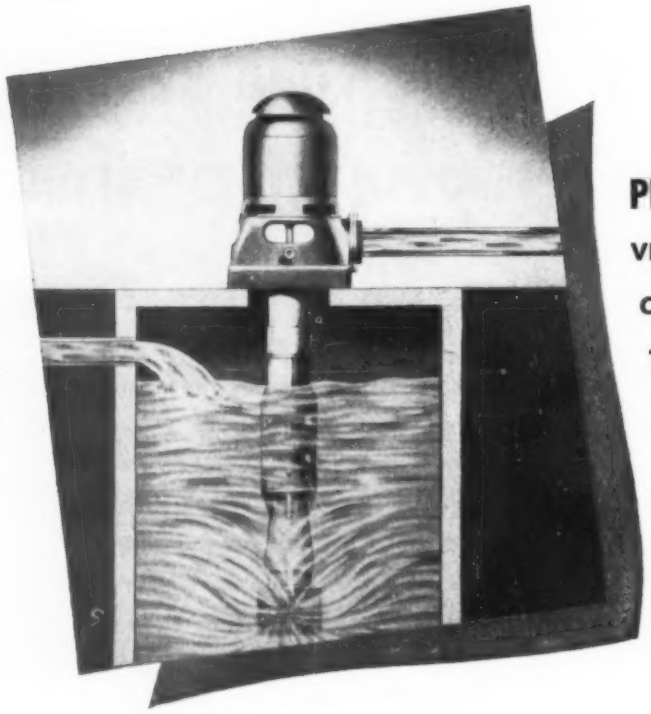
* * *

Book Review: During the past several years I've written a number of book reviews for this magazine. All of them concerned technical books devoted to this field. Right now I'd like to put in a plug for another book—completely non-technical—although it does mention the *Water Works Journal* in one place. It is an adult love story; its descriptive passages are excellent; its dialogue interesting; its story could have happened; and it is dedicated to a fellow who sells sewage works equipment. Oh, yes, it was written by a friend of mine.—"The Heart Has Reasons" by Nona Coxhead (Mrs. Paul Cerny), published by Scribners, is a story you'll like if you like fiction.

* * *

It was at the Pennsylvania Water Works Operators' Meeting at State College, Penna., that Dean Hammond gave one of the cleverest welcoming speeches I've heard anywhere. Picture in your mind a storm coming up as the registrants gathered at the Electrical Engineering Building. Picture, too, that at this session, Mike Glace conducted a Mr. I. Q. program and that the silver dollars he was to give away were stacked on the table in the front of the room.

Looking first at the fully packed room as the meeting got under way *on time*, and then at the stack of silver dollars, Dean Hammond said, "I don't know what kind of a meeting this is going to be, but it apparently took a rainstorm to drive you in on time and a stack of silver dollars to keep you here."



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TURBINE PUMPS

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FULL TURBINE PUMP UTILITY & CAPACITY

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Peerless Vertical, Close-Coupled Turbine Pumps offer a most efficient method of supplying and moving water from short settings. Ideal for installation over sumps, pits, basins, etc., where turbine pump utility and capacity are required. Capacities: From 15 to 30,000 G.P.M. For medium and high heads • Oil or water lubrication • Choice of Drives.

Request Bulletin B-159, describing the engineering, construction and application of Peerless Vertical Close-Coupled Turbine Pumps.

PEERLESS VERTICAL, *CLOSE-COUPLED* PUMP APPLICATIONS INCLUDE:
BOOSTING • RECIRCULATION • RESERVOIR PUMPING • REDISTRIBUTING • SETTLING AND CLARIFICATION • AIR CONDITIONING • CHEMICAL PROCESSING • WATER COOLING • MINE DEWATERING • COOLING TOWER

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The SIMPLEX
SAND EXPANSION GAUGE

Accuracy within 2% of actual sand expansion in all sizes and types of filter beds.

PUTS THESE WASH WATER FACTS At Your Command!

1. What wash water rate to use for maximum efficiency.
2. How long the proper wash period should be.
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The Simplex Sand Expansion gauge gives accurate facts about your filter washes which make it possible to arrive at the perfect wash water cycle for any given plant — in any period of the year. The obvious savings in wash water, filter material, time, and labor, make this dependable unit a vital part of your filtration plant equipment. In conjunction with the Simplex Wash Water Controller, the Sand Expansion gauge may provide complete automatic contorl of the preferred wash cycle.

This instrument is as easily installed in plants now operating as in plants under construction. It responds within 2% of the actual sand expansion in all types and sizes of filter beds; gives trouble-free, dependable service, and is low in initial cost.

Write today for full details on the inherent value of the Simplex Sand Expansion Gauge.

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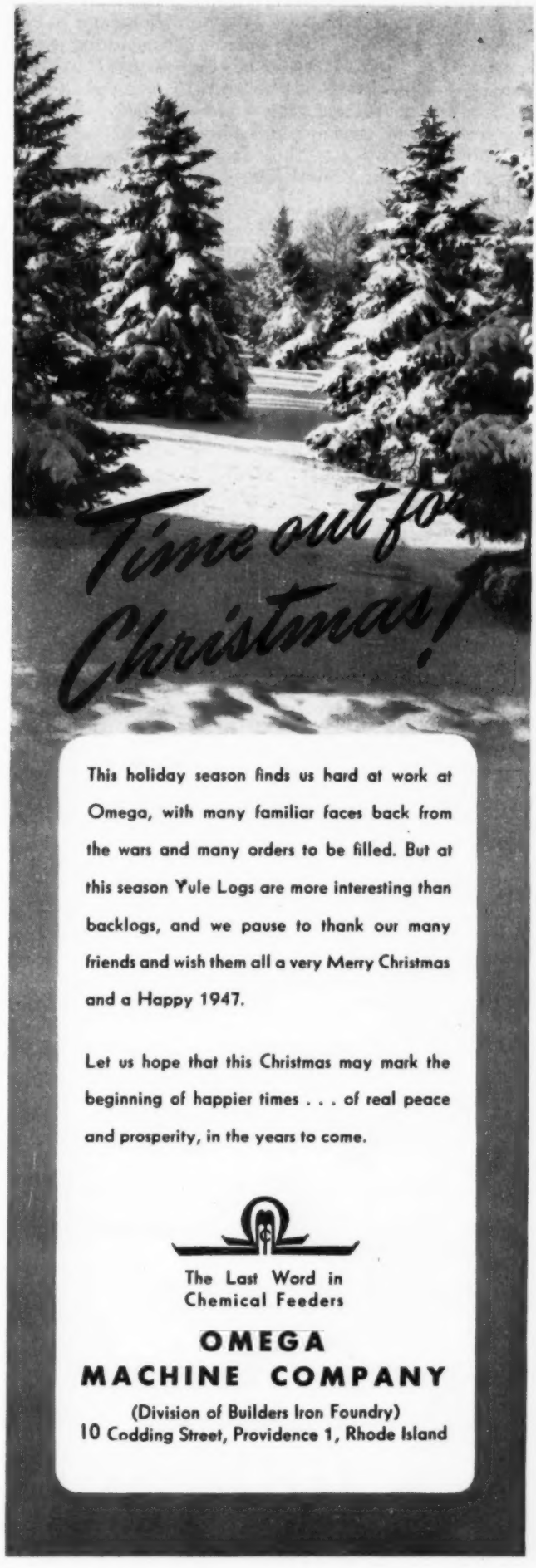

This holiday season finds us hard at work at Omega, with many familiar faces back from the wars and many orders to be filled. But at this season Yule Logs are more interesting than backlogs, and we pause to thank our many friends and wish them all a very Merry Christmas and a Happy 1947.

Let us hope that this Christmas may mark the beginning of happier times . . . of real peace and prosperity, in the years to come.

The Last Word in Chemical Feeders

OMEGA MACHINE COMPANY

(Division of Builders Iron Foundry)
10 Codding Street, Providence 1, Rhode Island

At the Santa Fe Meeting of the Rocky Mount. Section, A. W. W. A., Charles N. Davis, City Engineer, Denver, Colo., and Harry (Chlorine Institute) Faber were initiated into the Hopi Indian Tribe during a colorful ceremony at the meeting. They are now known by the Indian equivalent of "Brothers-Under-The-Blanket."

* * *

It's Official Now! For a number of years E. A. "Sig" Sigworth has handled the transportation committee work for the A. W. W. A. Conventions, but he had never been officially appointed to that position. So—to remedy this oversight, Sig has now received a bona fide appointment. The letter of appointment was truly official in its language and was signed and sealed by Harry E. Jordan, Exec. Secy., A. W. W. A. This document was then duly "approved by W. J. Orchard, General Convention Chairman," and was endorsed as follows: "Sam Newkirk, Past, and Tom Veatch, Future?"

* * *

Special Announcement No. 3. The special announcement that I promised last month I would make in this issue will not be made until next issue because there are too many other special announcements in this issue. And look for John Hood's letter on vacations in the next issue—Three 0 Bodie. V. T. Y. Doc.

GRINNELL SOCKET FITTINGS

SPACE-SAVING
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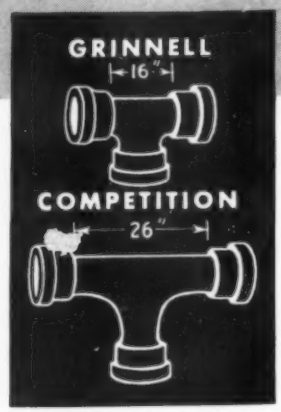

TEE

	Grinnell		Competition	
	Weight	Run from bell to bell	Weight	Run from bell to bell
4"	96 lbs.	11 in.	128 lbs.	22 in.
6"	147 lbs.	13½ in.	200 lbs.	24 in.
8"	222 lbs.	16 in.	294 lbs.	26 in.
10"	325 lbs.	19 in.	395 lbs.	28 in.
12"	417 lbs.	21½ in.	512 lbs.	30 in.

AND A COMPLETE LINE

You'll find convenience – and profits, too – in using modern Grinnell Socket Fittings. Compact, they are easier to handle, fit neatly into close quarters, speed installations. Friction loss is not increased. Socket and spigot dimensions and wall thicknesses are same as AWWA standard Class D pipe. Underwriters' Laboratories approved.

Specially coated with coal tar pitch varnish. Bends have lugs to take socket clamps.

Write for catalog: "Water Works Specialties."

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GRINNELL

WHENEVER **PIPING** IS INVOLVED

THE SPILLWAY

[Overflow from the main section]

John Pray Heads Newly Organized Iowa Section

Pederson Secretary-Treasurer

With the break-up of the old Missouri Valley Section, there was wonder in some parts as to what would happen in the four separate states. Two of the states had really organized before the Missouri Valley Section disbanded, and early in November of this year, Iowa, too, organized a section of A. W. W. A.

John W. Pray

H. V. Pederson

At the organization meeting held in Des Moines, more than 100 water works men attended. The first slate of officers elected for the ensuing year was as follows:

Chairman—John W. Pray, Mgr. of Utilities, Fort Dodge.

First Vice Chairman—J. J. Hale, Supt., Dubuque.

Second Vice Chairman—Roy O. Ellis, Mgr., Water Dept., Oskaloosa.

Secretary-Treasurer—H. V. Pederson, Supt., Marshalltown.

AWWA Director—Dale L. Maffitt, Gen'l. Mgr., Des Moines Water Works.

Two years ago there were less than sixty members of A. W. W. A. in Iowa and now the membership has reached more than seventy with new applications on file since the formation of the new section.

RUST & BITUMINOUS ENAMEL CORROSION

We are nationally known approved Applicators of Bituminous Coatings and NO-OX-ID for treating Steel Standpipes, Elevated Water Tanks, Water Mains, Penstocks, Lockgates and other Water Works installations.

IN CASES REQUIRING CATHODIC PROTECTION, WE RECOMMEND BITUMINOUS COATINGS TO ELIMINATE CORROSION AT WATER LEVELS AND ABOVE.

SEND FOR FREE BOOKLET

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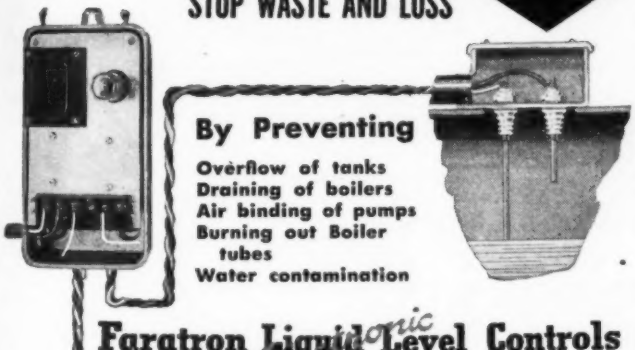
these ELECTRONIC stainless steel FINGERS

STOP WASTE AND LOSS



By Preventing

Overflow of tanks
Draining of boilers
Air binding of pumps
Burning out Boiler tubes
Water contamination

Faratron Liquid Level Controls

Just two polished stainless steel rods — that's all — in any vat, tank, boiler, reservoir, etc., to control signals or operate pumps or valves, automatically; they are constantly on duty — need no servicing — and are easy to install.

If you have any liquids — hot or cold — in any type of container — to control, you should have our Bulletin 611. Write for it today.

TO PUMP MOTORS— High or Low SIGNAL BELLS or LIGHTS— Motorized VALVES— Etc.

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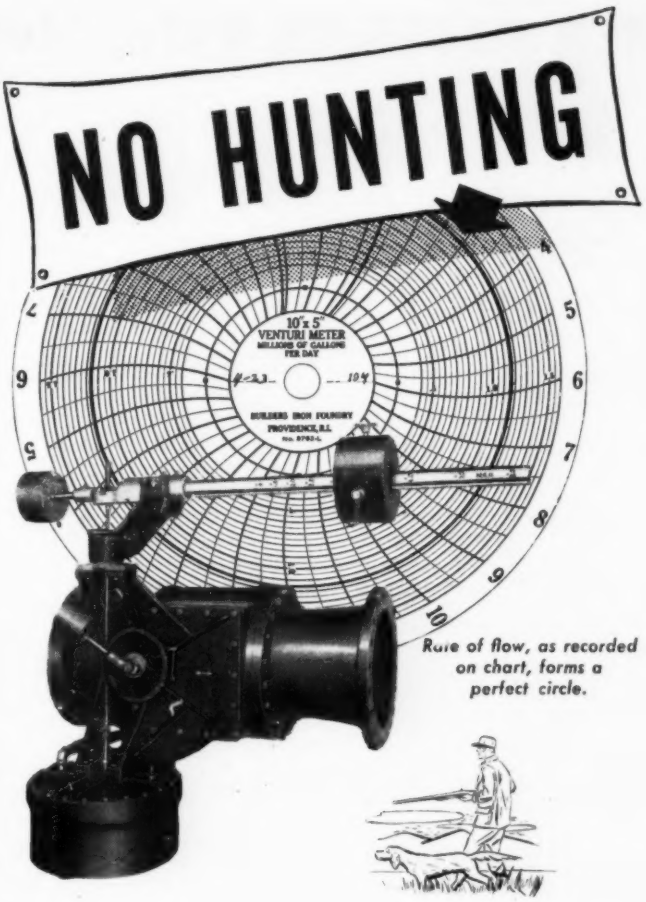
NO HUNTING



Rate of flow, as recorded on chart, forms a perfect circle.

PRECISION CONTROL OF FLOW ASSURED with BUILDERS CONTROLLER

The chart tells the story — there's no "hunting" with Builders direct acting rate of flow Controller! Anti-friction bearings throughout and close hydraulic coupling between diaphragm and Venturi tube permit quick response to the slightest change in flow, without lag or over run — compensating for every variation in filter head. The valve path is entirely clear of air pockets; Model RCE has the least tendency to "hunt" of any waterworks controller. Builders design combines nearly a half a century of laboratory research and the practical experience of leading waterworks engineers.

For Bulletin 321B with the complete story of accuracy, low maintenance and perfect control, address Builders-Providence, Inc., 10 Codding Street, Providence 1, R. I.

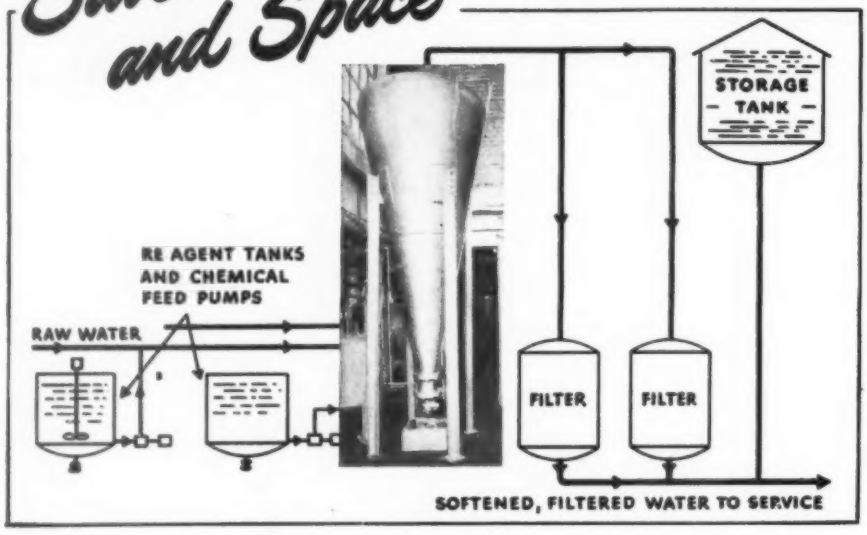
BUILDERS PRODUCTS

Venturi, Propelofio and Orifice Meters • Type M and Flo-Watch Instruments • Venturi Filter Controllers and Gauges • Master Controllers • Kennison Nozzles • Chronoflo Telemeters • Conveyor Scales

BUILDERS PROVIDENCE
Instruments

NEW SLUDGELESS WATER SOFTENER...

Saves time and Space



Permutit* Spiractor applies established principles in a new way

Permutit's Spiractor—latest addition to modern cold lime or lime soda water treatment—operates on the principle of intimate contact with solid nuclei for accelerated precipitation. The conical container—itself a great saving in space over other type systems—is more than half filled with fine granules of calcium carbonate catalyst. Hard water and lime soda precipitant enter at bottom, mix at once, flow upward through catalyst bed. This tangential inflow gives a rising swirling motion that greatly speeds softening reaction by affording immediate contact between chemically treated water and suspended granules.

Precipitated hardness deposits on the surface of these granules which increase in size. There is no watery sludge; the enlarged granules are readily disposed of like moist sand grains. Detention period of the Spiractor is only five to ten minutes.

For more information write The Permutit Company, Dept. W12, 330 West 42nd St., New York 18, N. Y., or Permutit Co. of Canada, Ltd., Montreal.

Trademark Reg. U. S. Pat. Off.

PERMUTIT

WATER CONDITIONING HEADQUARTERS

MECHANICAL EQUIPMENT BY ROBERTS FILTER MFG. CO. DARBY, PENNA.

KNOWN AROUND THE WORLD AS THE SIGN OF EXCELLENCE IN WATER TREATMENT EQUIPMENT

The years of experience behind the Roberts nameplate is your assurance that any water rectification problem is expertly handled to your best advantage. As manufacturing and installation engineers, the Roberts organization is equipped to meet your exact needs regardless of the size of the equipment or the complexity of the problem.

GRAVITY FILTERS • SOFTENING PLANTS AND EQUIPMENT • PRESSURE FILTERS ZEOLITE SOFTENERS • SWIMMING POOL RECIRCULATING APPARATUS SPECIAL WATER TREATMENT EQUIPMENT

We invite your inquiries

ROBERTS FILTER MANUFACTURING COMPANY • Darby, Pa.

Corrosion Symposium Held in Cleveland

Although water and sewage works associations were not participants, the corrosion symposium held in Cleveland in September may be of considerable importance to this field as time progresses.

The symposium was sponsored by the Cleveland sections of the American Chemical Society, the American Institute of Chemical Engineers, and the Electrochemical Society. The one-day meeting attracted a registration of 350.

The symposium considered the fundamental aspects of corrosion and the basic methods of metal protection. All of these methods are of particular interest to the field of water and sewage treatment; they are: Cathodic protection, either impressed on the system or by means of sacrificial anodes; metal coatings; inorganic and organic coatings; passivators and inhibitors; oxygen removal; metal purification; and alloys.

New England Section AWWA Inaugurates Technical Sessions

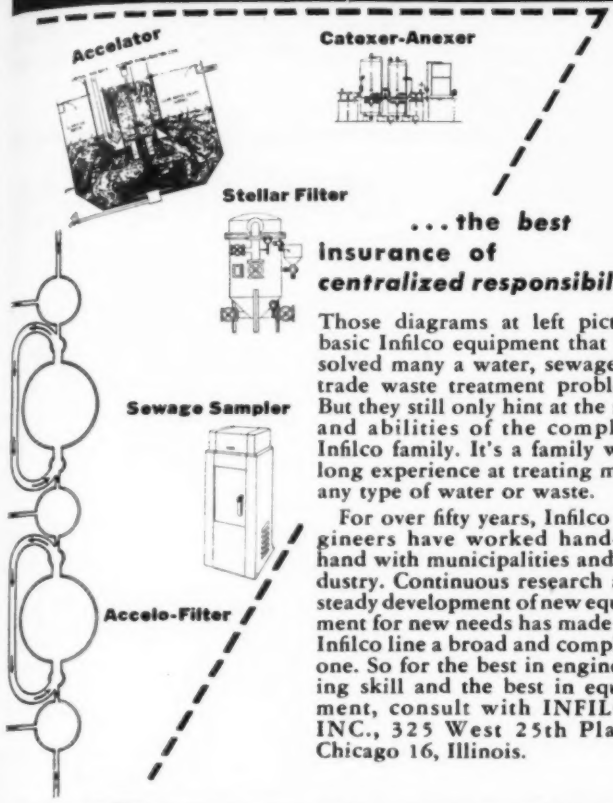
The New England Section of the AWWA was organized sixteen years ago with a membership of 22. At the present time its membership has grown to 69, but in the intervening years it has held no technical sessions, its members generally attending the meetings of the New England Water Works Association.

The first technical session of the Section was held at the Statler Hotel in Boston in October, Chairman W. P. Melley, Supt., Milton, Mass., presiding. Ellis A. Tarlton, Chemist of Danbury, Conn., Water Dept., conducted a Symposium on Water Treatment in New England for the first session.

N. T. Veatch, Consulting Engineer, Kansas City, Mo., and Vice-President, AWWA, spoke at the luncheon, and at the afternoon session Sidney S. Anthony, Supt. and Engr. of Augusta, Me., Water District, conducted a Panel Discussion on "Public and Personnel Relations in Water Works Management." Among the speakers on the Panel of Discussion were Roger W. Esty, Supt., Danvers, Mass., Water and Sewage Works, who spoke on the subject of Nuisance Charges. Percy A. Shaw, Supt. and Engr., Manchester, N. H., and F. J. Reny, Mgr. of Portland, Me., Water District, spoke on Water Utility Contacts with Management.

(*Continued on page 98*)

A complete family



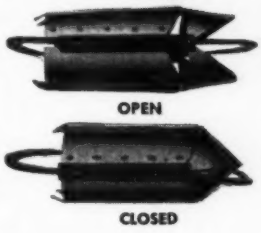
...the *best* **insurance of** ***centralized responsibility***

Those diagrams at left picture basic Infilco equipment that has solved many a water, sewage or trade waste treatment problem. But they still only hint at the size and abilities of the complete Infilco family. It's a family with long experience at treating most any type of water or waste.

For over fifty years, Infilco engineers have worked hand-in-hand with municipalities and industry. Continuous research and steady development of new equipment for new needs has made the Infilco line a broad and complete one. So for the best in engineering skill and the best in equipment, consult with INFILCO INC., 325 West 25th Place, Chicago 16, Illinois.

CONSULT INFILCO — FIRST IN WATER AND TRADE WASTE TREATMENT

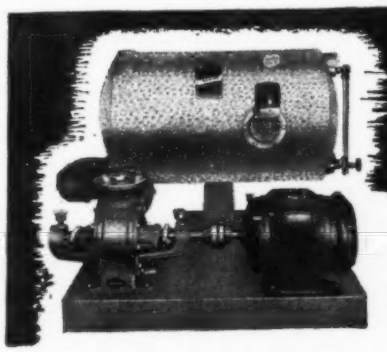
KEEP SEWERS OPEN with OK CHAMPION POWER SEWER CLEANER



Town and City officials throughout America are adopting OK CHAMPION Power Sewer Cleaner to keep sewers clean and efficient. Takes roots, dirt, sand, and other debris up from main in one continuous operation. All men work above street level.

Pulling forward opens the jaws that bite into obstructions. Reversing the pull on the bucket automatically closes jaws which hold load pulled back to street level. Write for complete details.

CHAMPION CORPORATION 4718 SHEFFIELD HAMMOND, IND.



CONDENSATE RETURN at its BEST

Capacities to 150 G.P.M.
(Both Horizontal and Vertical)

APCO Horizontal Simplex Condensation Return Unit

These units are available in simplex and duplex types—designed for the automatic return to high and low pressure boilers of the hot water condensation from radiators, coils, etc. Catalogued in sizes ranging from 2,000 to 100,000 sq. ft. equiv. radiation. Larger sizes available.

APCO TURBINE-TYPE PUMPS

Apcos are ideal for the above service or any small capacity, high head duty. The one moving part, the impeller, is free running, therefore unaffected by heat expansion. Ability to maintain practically constant capacity against drastic pressure conditions is another of many distinctive features.

AURORA CENTRIFUGALS
for Every Pumping Job
HORIZONTAL SPLIT CASE
Single & Two Stage
SIDE SUCTION
VERTICAL
NON CLOG
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SPECIAL DESIGN
Write for
CONDENSED CATALOG "M"
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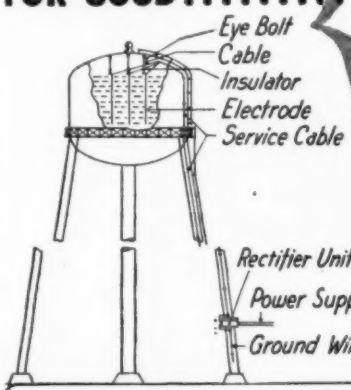
AURORA Always PUMPS — AURORA PUMP COMPANY
68 Loucks Street, AURORA, ILLINOIS

End UNDERWATER CORROSION FOR GOOD.....



Corrosion stopped electrically on submerged surfaces of tanks, standpipes, flocculators, clarifiers, pipe lines and other water handling equipment.

No interruption of tank operation to install.

Corrective current properly distributed to all submerged areas for complete protection.

Low initial cost compares to one good tank cleaning and repair job.

No chemicals or moving parts.

Operation cost negligible.

Fully guaranteed.

Write for fact-filled folder.

H

ELECTRO RUST-PROOFING *Corporation*
BELLEVILLE 9, NEW JERSEY, U. S. A.

Harold W. Griswold, Deputy Mgr. and Deputy Chief Engr. of the Metropolitan District of Hartford, Conn., read a paper on "Personnel Problems as Related to Union Activities."

Waste Disposal and Safety

Perhaps it may seem strange to many of our readers to learn that at the 34th National Safety Congress held in Chicago in October the subject of industrial waste disposal was discussed. The session on waste disposal was sponsored jointly by the Chemical Section of the National Safety Council and the American Society of Safety Engineers. One of the papers presented was on waste sulfite liquor disposal by J. Richter Salvesen of the Marathon Corp.

Jerome F. Seaman and E. E. Harris, both of the Forest Products Laboratory of the U. S. Dept. of Agriculture, presented a paper on the Utilization of Waste Liquor in Germany, and R. E. Lester of the Calco Chemical Division of American Cyanamid Co. discussed problems encountered in the design of a waste disposal system.

A general approach to the whole problem of industrial waste disposal was presented by Robert W. Heider of the Indiana State Board of Health, who spoke on Industrial Waste and Stream Pollution.

Even those sparkling brooks that feed the water supply of smaller cities aren't as pure as they look. They drain stagnant marshes, flow past contaminating barnyards. Sparkling brooks aren't necessarily pure water. And if water isn't **pure**, it isn't **safe**.

Germ-laden water that has been treated with SOLVAY Liquid Chlorine is safe every second of every day.

Municipal engineers rely on this chlorine bactericide to make drinking water **safe**.

Write Solvay for details of "washing" water to make it safe with SOLVAY Liquid Chlorine.

"SPECIFY QUALITY—*SPECIFY* SOLVAY"

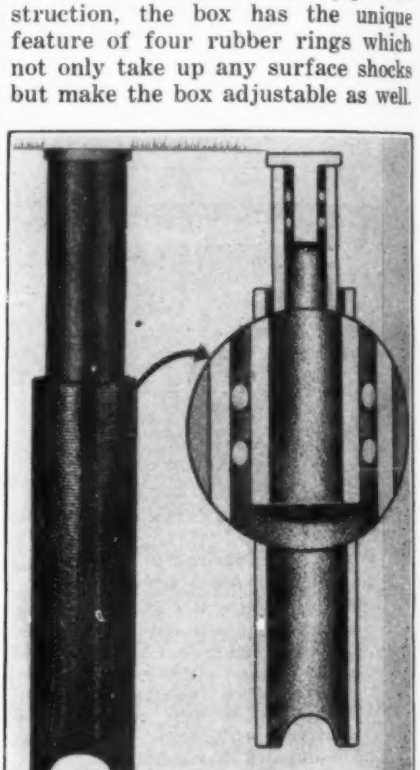
SOLVAY LIQUID CHLORINE

SOLVAY SALES CORPORATION
Alkalies and Chemical Products Manufactured by The Solvay Process Company
40 Rector Street New York 6, N.Y.

MANUFACTURERS' and EQUIPMENT NEWS

Shock-Proof Curb Service Box

The Pilot Engineering Service of Milwaukee has developed and is now marketing a new type of curb service box called the G-H Shock-Proof Curb Service Box. Made of fibre pipe construction, the box has the unique feature of four rubber rings which not only take up any surface shocks but make the box adjustable as well.



This box is light and easy to install, cannot shear the service pipe, cuts maintenance costs because it lasts a lifetime. Furthermore, it is resistant to freezing, and its lightness makes for ease of handling.

The new box is available in lengths and sizes to meet various grade conditions. Caps for the service box are available for either water or gas installations.

Further information on the Fireye Electronic Combustion Safeguard System may be obtained from the Combustion Control Corp., 77 Broadway, Cambridge 42, Mass.

Al Frank Upped at National Water Main Cleaning

The Board of Directors of the National Water Main Cleaning Co. has announced the election of J. A. Frank to the position of Vice President. Mr. Frank was previously Chief Engineer and Field Manager of the company. Literally growing up with the industry, "Al" Frank received his degree as Mechanical Engineer from Stevens Institute in 1933 and holds a Prof. Engrs. license in the State of New Jersey.

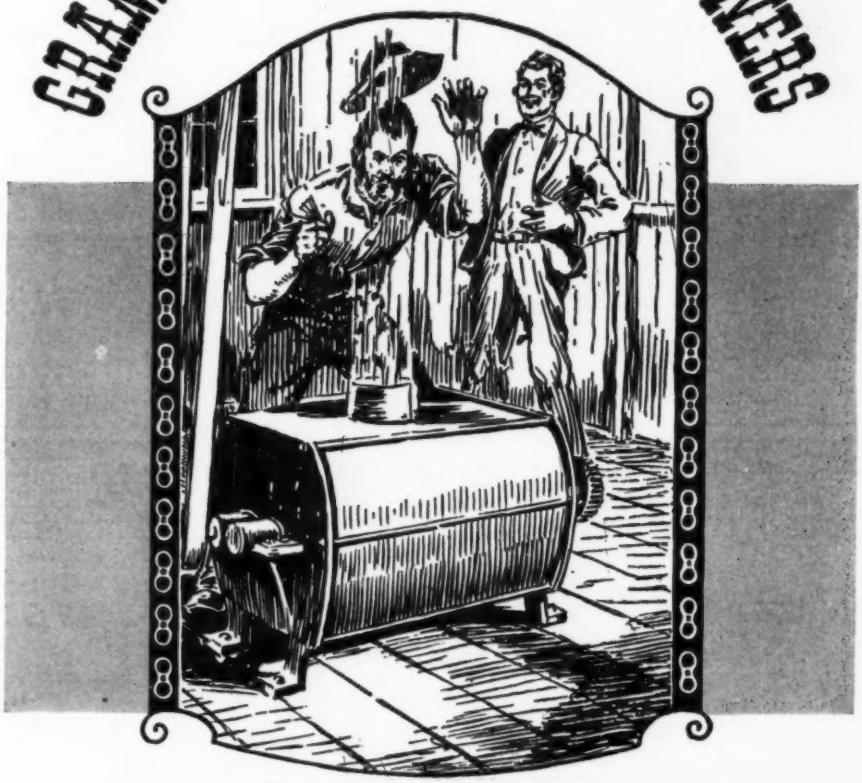
J. M. Robinson New York Representative for Rensselaer

Announcement has been made by the Rensselaer Valve Co. of the appointment of James M. Robinson to cover the New York territory for the

company. Robinson served as radar officer on Admiral Kincaid's flagship and was in three major engagements in the Pacific. During the early part of the war Robinson was in charge of production planning for the Sterling Engine Company's Admiral engine for PT boats, and was later Manager of the Development Division of Curtiss Wright Corp.

Mr. Robinson is the son of the late F. Hurd Robinson, who was superintendent of Public Works and City Engineer of Hornell, N. Y.

GRAND DADDY OF 250,000 BLOWERS



"That's a better blower than the fan on my foundry cupola."

The double impeller principle in Rotary Positive Blowers came from this water motor with its wooden impellers in an iron case, devised by the Roots brothers in 1854. It led to the establishment of one of our predecessor companies.

Since then, we have built 250,000 blowers, meters, exhausters, vacuum pumps and similar equipment, whose successful performance has been demonstrated in practically every industry.

For many years, we built only Rotary Positive units. Then, as new products and processes showed a growing need for Centrifugal equipment, we expanded our activities. Today, R-C *dual-ability* to supply either type gives users the advantages of unprejudiced engineering.

So, whatever your need may be for moving or measuring air or gas, and for many liquid applications, you can depend upon R-C *dual-ability* for long-time, profitable performance.

ROOTS-CONNERSVILLE BLOWER CORPORATION
One of the Dresser Industries
612 Mount Avenue, Connersville, Indiana

Roots CONNERSVILLE SINCE 1854

BLOWERS FOR EVERY NEED

ROTARY POSITIVE AND CENTRIFUGAL BLOWERS • EXHAUSTERS • BOOSTERS
LIQUID AND VACUUM PUMPS • METERS • INERT GAS GENERATORS

84" pipe—Spring Lake, N. J.

FLANGED PIPE

FLEXIBLE JOINT PIPE

BELL & SPIGOT PIPE

SPECIAL CASTINGS

SHORT BODY BELL & SPIGOT SPECIALS

Large stock enables us to make prompt shipments.

CAST IRON PIPE

SIZES 2" TO 84"

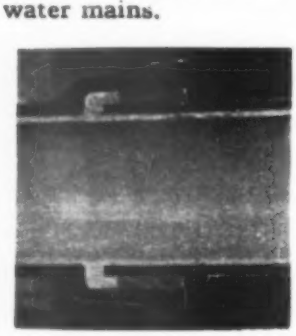
Warren Foundry & Pipe Corp.

11 Broadway, New York

Warren Pipe Company of Mass., Inc.

The TATE *Cement Lining Process Restores efficiency of old Water Mains*

Now is the time to investigate the Tate Cement Lining process —and see what it can do to restore the efficiency of your old water mains.



View showing Tate Process in Pipe Joint. Note thoroughness of Lining.

Write for Literature.

What the TATE Process accomplishes

1. Water mains cleaned and cement-lined without removing pipe.
2. Eliminates discoloration and further cleaning costs.
3. Reduces pumping costs.
4. Restores reduction in head and flow co-efficients. This means full fire protection and lowered insurance rates.
5. All joints cement-lined . . . just one continuous pipe.
6. Does the job without interruption of service to consumer.

TATE PIPE LININGS, Inc.

ANDOVER, MASS.

Sherman Machine and Iron Works Represents Permutit

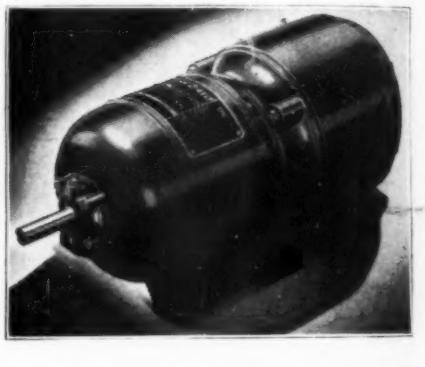
The Permutit Co. of New York has announced the appointment of the Sherman Machine and Iron Works as Sales Representative for the Southwest territory. The Sherman Machine and Iron Works is located at 2-26 East Main St., Oklahoma City 2, Okla.

Link-Belt Electrofluid Drive

The Link-Belt Co. of Chicago has announced a new and revolutionary type of "packaged" power unit to be known as the Link-Belt Electrofluid Drive.

Available at present up to 20 horsepower, the unit is a compact motorized hydraulic combination consisting of a general-purpose A.C. induction motor, flange-mounted on a sturdy housing containing a hydraulic coupling (fluid coupling).

Each fluid coupling has two elements, primary (impeller) and secondary (runner); the former is connected directly to the motor shaft and the latter to the unit to be driven. The housing is filled with light mineral oil of steam turbine quality. When the motor drives the impeller it causes the oil to flow through the runner buckets and back to the impeller, thereby rotating the runner through the oil as the medium of power transmission. There is no mechanical connection between the two elements. The fluid serves as an automatic clutch.



This new unit has many advantages; it solves the problem of inadequate torque and excessively high starting current peaks; it absorbs the energy of the motor rotor and protects the driven machine from shock; it eliminates torsional vibration; it has smooth, easy pick-up; it permits use of the motor selected for the load normally developed, and should the driven machine become stalled, it produces maximum torque capacity on the motor and causes the

overload protective device to function quickly.

This new Electrofluid Drive Unit may be obtained from the Link-Belt Co., 307 N. Michigan Ave., Chicago 1, Ill.

E. E. Peavy S.W. Dist. Mgr. for Dresser

According to an announcement from H. Z. Hight, Sales Manager of the Dresser Manufacturing Division, Elton E. Peavy has been appointed to the position of Southwest District

E. E. Peavy

Manager for the sale of Dresser products to the water industry. Mr. Peavy will cover the southwest territory, including Texas, Louisiana, Oklahoma, Arkansas, Mississippi and New Mexico, and will handle Dresser Couplings, Fittings, and Repair Products.

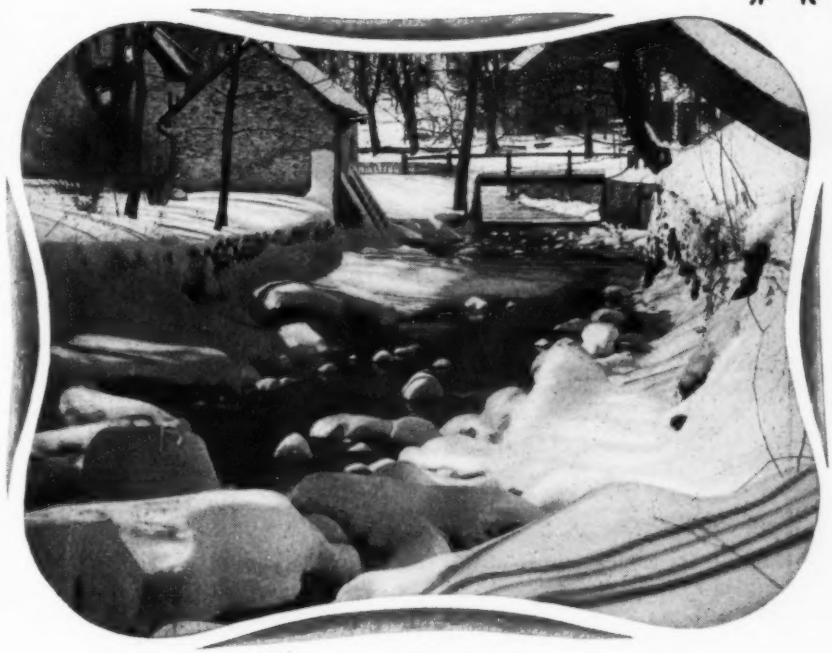
Mr. Peavy succeeds H. R. Shidel, who will direct the sale of Dresser Welding Fittings in the area. A graduate of Southern Methodist University, Mr. Peavy had a wide acquaintance in the water field before joining the Dresser Manufacturing Division, Bradford, Penna.

American Concrete Pipe Assoc. Holds Regional Meetings

During the month of November the American Concrete Pipe Association held four western and midwestern meetings; one at Fresno, Calif., for the California Associated Concrete Pipe Manufacturers; one at Denver; two other regional meetings were at Kansas City, Mo., and Austin, Texas.

The regional meeting program was adopted by the board of directors of the A. C. P. A. during its regular session last spring. It is a measure of additional service to association members. Mr. Howard F. Peckworth, managing director of the Association, reported at each meeting; recent advances in technological and scientific processes were presented.

NOW...
QUALITY WATER



AT
LOW TEMPERATURES

During winter months also, you can produce better quality water when you coagulate with an N-Sol Process. With the N-Sol Silicate processes of coagulation, the floc is large, tough, and rapid-settling, regardless of temperature.

Measurable results are lower turbidity, longer filter runs, increased plant capacity.

Before you complete plans for a new filtration plant, know more about the N-Sol Process for summer or winter coagulation. Complete information is available for the asking.

These processes fit any coagulating procedure — save space, save money.

N-Sol-A° — N Brand reacted with ammonium sulfate. Used where chloramine sterilization is desired.

N-Sol-B — N Brand reacted with alum. Used with any sterilization procedure. (U. S. Pat. 2,310,009)

Baylis Sol — N Brand reacted with sulphuric acid. Used with any sterilization procedure. (U. S. Pat. No. 2,217,466)

°Patent Applied For

N-SOL PROCESSES FOR WATER COAGULATION

DEVELOPED AND PATENTED BY
PHILADELPHIA QUARTZ COMPANY, PHILADELPHIA 6
AVAILABLE UNDER LICENSE WITHOUT CHARGE

L&S

STEVENS POSITION RECORDER

for Remote Registration

Type PAV

TYPE PAV qualifies for a multitude of uses—recording and indicating water levels, gate positions, valve openings, heads on turbines and pumps, or the remote registration of the position of any moving element.

Built for vertical mounting on wall or panel, the Type PAV is similar in principle to the Stevens Type A35 Recorder with a position motor substituted for the float pulley, thus converting the instrument into a remote registering recorder.

Pen is actuated by a distant position motor transmitter. Quality electric clock is standard equipment. Strip charts are available in 25-yard rolls for either English or metric units.

This versatile remote registration recorder is fully illustrated and described in Bulletin P15. Write for your copy.

LEUPOLD & STEVENS INSTRUMENTS

Manufacturers since 1907

PORTLAND 13, OREGON

Hydrographic • Surveying • Navigation
Automatic Controls

Leupold & Stevens Instruments
4445 N. E. Glisan St., Portland 13, Oregon

Please send Bulletin No. P15 on the Stevens *Type* PAV Recorder.

Name _____

Organization _____

Title _____

Street _____

City _____ *Zone* _____ *State* _____

G-E Organizes New Corporation

The General Electric Appliances, Inc., is a new corporation organized to carry on business formerly conducted by nine G-E Appliance Distributing Branches of the General Electric Company. The corporation's headquarters are at Bridgeport and management and operating personnel of the branches remain unchanged, as does their location, according to the announcement by Charles E. Wilson, president of the General Electric Company.

J. M. Sprague Joins Clay Sewer Pipe Assn.

The Clay Sewer Pipe Assn. has announced the addition to its staff of Joshua M. Sprague. Sprague attended the University of Miami and Columbia University and has been connected with the War Research Laboratory at Columbia University since 1943.

In his new position Mr. Sprague is to be District Engineer for the association in the State of New York and the Atlantic Seaboard, with his office located at 26 Court St., Brooklyn, N. Y.

Liquid Conditioning Corp. Appoints Three District Managers

The Liquid Conditioning Corp. of New York recently formed a company for the manufacture of equipment for softening and clarifying liquids, and has announced the appointment of three district managers.

In the Cincinnati territory, Ira J. Bready will handle the company's products. In the Lower Michigan district, with headquarters in Detroit, same position will be filled by B. F. Soffe. In the central and lower South, H. H. Morrison will act as district manager, with headquarters in Chattanooga.

WRITE FOR INFORMATION

VOGT BROTHERS' TRAFFIC MODEL FIRE HYDRANT

A.W.W.A.

VOGT BROTHERS MFG. CO. Incorporated LOUISVILLE KY

MAIN AT 14th

VOGT

VOGT MFG. CO., Incorporated LOUISVILLE KY

P. O. BOX 1122

AERO-MIX

AERATOR—MIXER

A Size and Type to Fit Your Problem In Water or Sewage Treatment.

WRITE FOR INFORMATION

MR. SUPT:—

Sure! You can superchlorinate and avoid high residual chlorine taste when—

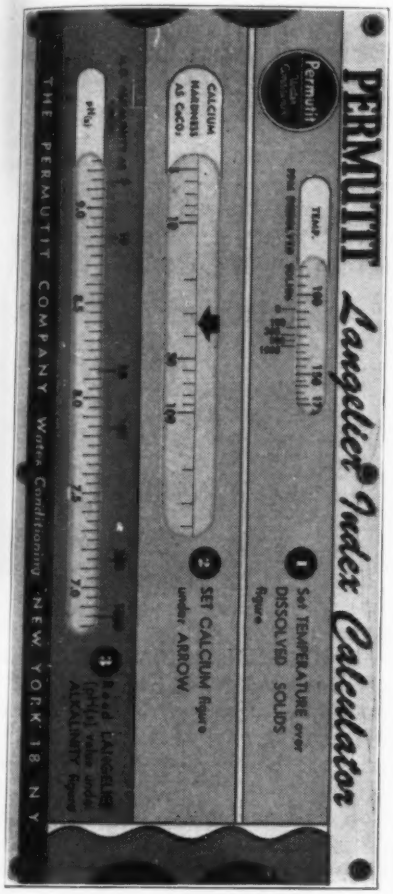
you post-treat with Virginia's "ESOTOO".

Write us today.

VIRGINIA SMELTING COMPANY
WEST NORFOLK, VIRGINIA

Langlier Index Calculator Offered by Permutit

The Permutit Co. has made a handy slide rule type of calculator for determining the Langlier Index of a water. If the temperature, alkalinity, dissolved solids, and calcium hardness of a water are known, it is a simple procedure to set the top slide so that the temperature and the dissolved solids lines coincide. The next operation is to set the calcium


PERMUTIT Langelier Index Calculator
THE PERMUTIT COMPANY Water Conditioning NEW YORK 18 N Y
Permutit
TEMP.
CALCIUM HARDNESS AS CaCO3
1 Set TEMPERATURE over DISSOLVED SOLIDS figure
2 SET CALCIUM figure under ARROW

hardness (as $CaCO_3$) at the arrow on the temperature-solids slide. Thereafter the Langlier Index (pH value) can be read from the bottom scale under the methyl orange alkalinity.

The Langlier Index gives a measure of the relative corrosiveness of water in that it gives the pH of the water when saturated with respect to calcium carbonate, which may be compared to the actual pH of the water.

On the reverse side of the "slide rule" are one-half and one-quarter scales, and a table of data on vertical tanks, including area of cross-section and volume in gal. per ft. depth, for diameters from one to 27 ft.

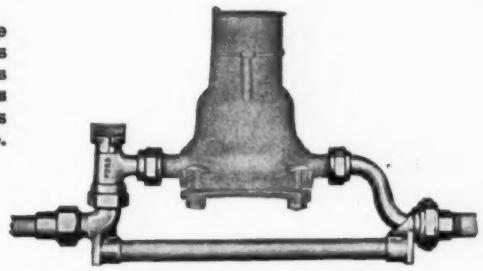
The Langlier Index Calculator Rule may be obtained merely for the asking from The Permutit Co., 330 W. 42nd St., New York 18, N. Y.

LINESETTERS

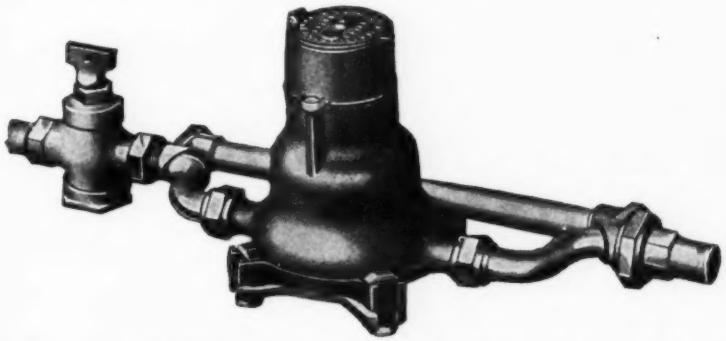
Water meter couplings, permanently connected and electrically bonded.

The Linesetter establishes a constant, correctly aligned, properly spaced opening in the line for the meter; provides a permanent physical connection for the inlet and outlet service piping; serves as an electrical bond around the meter; saves ordinary meter couplings, electrical bonding and other fittings; AND MAKES METER CHANGES EASY AND TROUBLE-FREE BECAUSE INLET AND OUTLET PIPING ARE HELD CONNECTED AND UNDISTURBED EVEN WHEN THE METER IS REMOVED.

LINESETTERS are made in plain and valve types and with various kinds of connections. Valve is the same as the famous Ford RINGSTYLE valve.



In shallow outside settings the Linesetter raises the meter 2½" above the service line level, keeping it cleaner and easier to read.



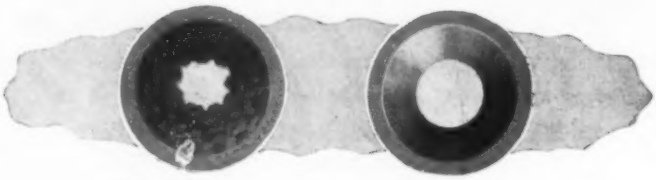
In basements the Linesetter is ordinarily placed in a horizontal plane. With the Linesetter there is no danger of starting leaks which frequently occur when old piping is disturbed by changing meters between ordinary couplings.

WRITE FOR INFORMATION ABOUT LINESETTERS

The

FORD METER BOX COMPANY, INC.,

WABASH, INDIANA



Before Cleaning After Cleaning

The Trade Mark of a Nation-Wide Organization

From Washington, D. C., to the Pacific, North, South, East and West, National Water Main Cleaning experts stand ready to serve you —guaranteeing to restore your mains to 95% of original capacity.

For as many as 40 years—longer than most water works men have been engaged in their professional work, National Water Main Cleaning Company has been building up an organization of engineers trained in the art of rehabilitating water lines.

This "95% performance" is now accomplished more quickly and with less disturbance to your normal operation than was ever possible before.

To put your water distribution system into first class condition for maximum service get in touch with our nearest office.

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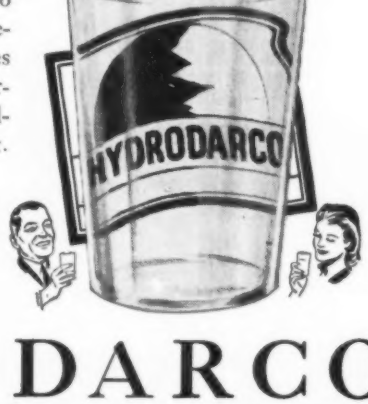
GOOD WATER MAKES SATISFIED CUSTOMERS

You can win and hold the good will of your public by standardizing on Hydrodarco for water purification. This special activated carbon eliminates odors and bad-tasting impurities with absolute dependability at surprisingly low cost.



HYDRODARCO

DARCO CORPORATION

60 EAST 42ND ST., NEW YORK 17, N.Y.

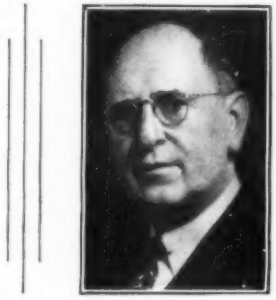
H. K. Porter Co. Moves Quimby Pump to Pittsburgh

The H. K. Porter Co., Inc., of Pittsburgh has announced that it is moving the two Quimby Pump manufacturing operations now in New Jersey to be centralized in the main company's plant in Lawrenceville, near Pittsburgh. The H. K. Porter Co., Inc., acquired the Quimby Pump Co. in 1943.

Rockwell Acquires Ohmer Corp.

N. J. Kenny Pres. of New Subsidiary

The Rockwell Manufacturing Co., Pittsburgh, has announced the purchase of the Ohmer Corp. of Dayton, Ohio. The Ohmer Corp. manufactures taximeters, fare registers and



cash registers. To be president of the new subsidiary the board of directors elected N. J. Kenny of Pittsburgh. Mr. Kenny will be remembered by his friends in the water works profession as President of the National Meter Co. for many years before it was acquired by the Rockwell Mfg. Co. With the acquisition of the Ohmer Corp., the Rockwell Mfg. Co. now has twelve wholly owned subsidiaries and divisions.

Hagberg to Cleveland for Nuchar

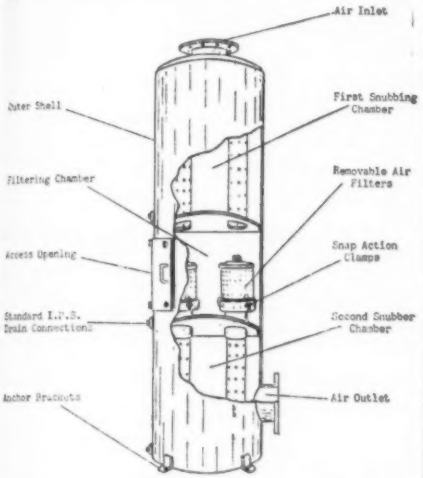
The Industrial Chemical Sales Division of the West Va. Pulp & Paper Co. has announced the appointment of Ralph A. Hagberg as Manager of the Cleveland District. Mr. Hagberg is a graduate of Tufts College and has been associated with the company since 1937, first as chemical engineer in the Research Dept. of Tyrone, Pa., and from 1939 to 1943 in the Technical Sales and Service Dept. in the New York office. In 1943 Mr. Hagberg was commissioned as a Lieutenant in the Sanitary Corps and spent nearly two years in the Pacific, nearly ten months of which were spent on Iwo

Jima, where he was promoted to a Major.

Released from the Army in 1946, Mr. Hagberg spent 6 months in the Research Department of the company before being appointed to the position of District Manager at Cleveland.

Burgess Air Intake Cleaner Snubber

The Burgess-Manning Co. of Chicago have announced a Combination Air Intake Cleaner Snubber. This unit is recommended for positive displacement blower and pump scavenged 2-stroke cycle Diesel and gas engines, and for atmospheric and positive displacement blower supercharged Diesel and gas engines.



The unit has the conventional three chamber side outlet construction for best performance and simplified installation (one cleaner and two snubbing chambers). Other advantages include a large access opening for servicing the filter elements, heavy duty, light weight filtering elements with a maximum area for minimum size.

Further information may be obtained from Burgess-Manning Co., 2815 West Roscoe Street, Chicago 18, Ill.

C. F. Codrington Promoted at A-C

Charles F. Codrington has been promoted from assistant to the manager to sales manager of the Blower and Compressor Department of the Allis-Chalmers Mfg. Co. of Milwaukee.

Codrington joined the company in 1930 following his graduation from Texas A. & M. He has been intimately connected with the development of the department's line of rotary compressors and vacuum pumps.

"VIC" VICTAULIC SAYS...
"Victaulic Full-Flow Fittings move fluids quick-'n-easy"
"...and in any direction! Full-Flow Fittings have wide, sweeping turns, without internal projections and pockets. They can be swiveled and set at any angle through 360° and can be independently removed from the line. Their construction is strong and efficient; their design is modern.
"Avoid a sluggish flow with conventional fittings that have short, sharp turns and internal projections. Switch to Victaulic Full-Flow Fittings for increased delivery and lower pumping costs.
"The right team-mate for these fittings is the famous Victaulic Coupling. Together they offer you the finest in piping systems.
"For economy, efficiency and dependability, use Victaulic Couplings and Victaulic Full-Flow Fittings."
Write for new Victaulic Catalog and Engineering Manual
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Victaulic, Inc., 727 W. 7th St., Los Angeles 14, Calif.
Victaulic Company of Canada, Ltd., 200 Bay St., Toronto
For export outside U. S. and Canada: PIPECO Couplings and Fittings: Pipe Couplings, Inc., 30 Rockefeller Plaza, New York 20, N. Y.
Have you considered Victaulic for your piping requirements?
Sizes—¾" through 60"
SELF-ALIGNING PIPE COUPLINGS
VICTAULIC
EFFICIENT FULL-FLOW FITTINGS
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GOLDEN-ANDERSON
design and build
over 1500
types and sizes in
automatic
VALVES
for safe protection
on any high pressure
installation

In addition to more than 1500 standard types and sizes of manual or automatic steam and water service valves — GOLDEN-ANDERSON engineers design and build special valves to meet most any difficult high or low pressure service.

Write today for descriptive, technical catalog.

GOLDEN-ANDERSON
VALVE Specialty Company
PITTSBURGH 22, PA.

George Torrence President of Link-Belt

George P. Torrence, executive vice-president of the Link-Belt Co. since July, 1946, has become President of the company, succeeding William C. Carter, who has retired in accordance with the company policy.

Mr. Torrence, a graduate of Purdue University, joined the company in 1911 as draftsman and rose through the company to the position of President in 1932. He resigned as president in 1936 to become general manager of the Rayon Machinery Corp. from 1936 to 1944 and president of the Cleveland Pneumatic Tool Co. from 1944 to 1946, when he returned to the Link Belt Co. as Exec. Vice Pres.

J. T. Myers Vice President Davey Compressor

Election of J. T. Myers as Vice President in charge of sales and production of the Davey Compressor Co. of Kent, Ohio, has been announced. A graduate of Duke University, Myers has been with the company for the past five years. During the war Myers was an engineer officer aboard a mine sweeper and later in the Naval Engineering Laboratories.

Westinghouse to Supply Motors for Grand Coulee

The Westinghouse Electric Corporation will build four 65,000 horsepower electric motors for pumping the water from the Grand Coulee dam into the semi-arid regions of south-central Washington. These motors which have been ordered by the

LEADITE
The Pioneer Self-Caulking Material for C. I. Pipe

TABLE OF COMPARATIVE QUANTITIES

Nominal inside dia. of pipe, in.	Depth of joint, inches of Leadite	Approx. lbs. of Leadite per joint	Depth of joint, inches of lead	Approx. lbs. of lead per joint
4	2.5	2.00	2.25	8.56
6	2.5	3.00	2.25	11.71
8	2.5	4.00	2.25	14.63
10	2.5	5.00	2.25	17.70
12	2.5	6.00	2.25	20.86
14	2.5	7.00	2.25	24.02
16	2.5	8.25	2.25	33.07
18	2.5	9.25	2.25	36.88
20	2.5	10.50	2.25	40.71
24	2.5	13.00	2.50	53.02
30	2.75	16.00	2.50	65.36
36	2.75	19.00	2.50	77.96
48	3.50	30.00	3.00	121.15
54	4.0	38.00	3.00	135.60
60	4.0	42.00	3.00	150.70

THE LEADITE COMPANY
Girard Trust Co. Bldg., Philadelphia 2, Pa.

No Caulking

HYDRO-TITE

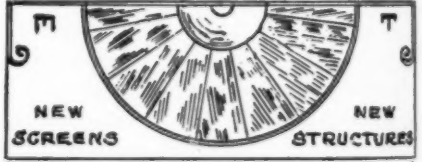
HYDRO-TITE — The self-caulking joint compound that makes cast iron water pipe joints — strong — tight — flexible and everlasting. Used on thousands of miles of pipe with a record of more than 30 years without a failure.

FIBREX — The sanitary paper packing that is used like braided jute. Free from bacteria — treated with a water repellent — put up in 60 pound reels. 70 pounds of Fibrex takes the place of 100 pounds of braided jute.

HYDRAULIC DEVELOPMENT CORPORATION
50 Church St.
New York, N. Y.

DRY BRAIDED
Fibrex

FINE SCREENS
FOR
SEWAGE
AND
INDUSTRIAL WASTES
TREATMENT



FORMER CONCEPTIONS
COMPLETELY OUTMODED

NO COSTLY, POWER CONSUMING REVOLVING BRUSH ARMS—25% GREATER SUBMERGED AREA.

NEW SCREEN PLATES FOR THE ECONOMICAL USE OF A FILTER MEDIA ON THE SCREEN, THUS INSURING GREATER REMOVALS THAN POSSIBLE HITHERTO.

COMPLETELY AUTOMATIC CONTROL POSITIVE SEAL RINGS.

MODERN DESIGN
HIGHEST EFFICIENCIES
LOWEST COST

SANEQUIPMENT ENGINEERING
2843 WHITEWOOD AVE.
ANN ARBOR, MICHIGAN

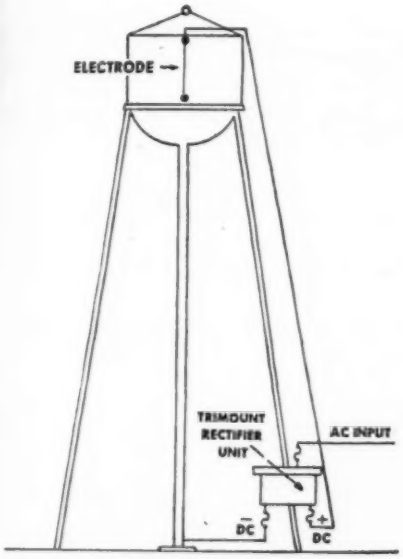
DESIGNERS — CONSULTANTS

U. S. Bureau of Reclamation will exceed, by more than 50 per cent, the capacity of the most powerful single alternating current motor now in existence. Each of the motors will be as powerful as ten of the largest locomotives and with its giant pump can move enough water to supply the requirements of a city the size of New York.

When completed the motors will dwarf anything ever previously built along this line. The rotor of each motor alone will weigh 172 tons and the completed motor will weigh 325 tons. To walk around the base of the motor requires the travel of more than 100 feet and the motor itself will stand 25 feet high.

Cathodic Rectifier Unit

A new cathodic rectifier unit for the corrosion protection of steel water tanks and deep well pumps has been announced by the Trimount Instrument Co. of Chicago.

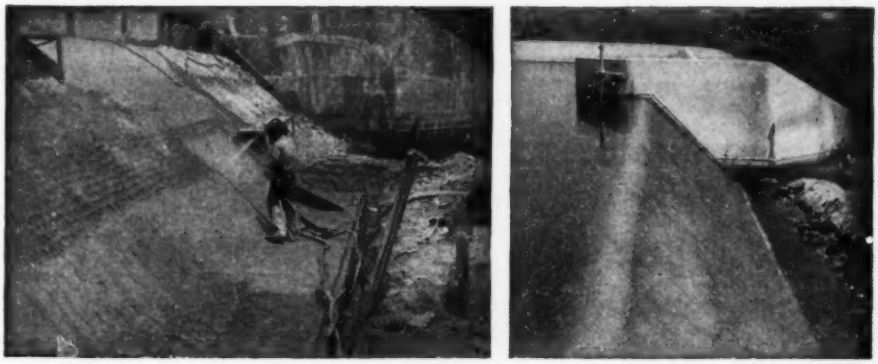


ELEVATED WATER TANK

Operating on the general principle of cathodic protection, this unit is contained in a weatherproof steel cabinet and has a D.C. output capacity of 2 to 5 amps. at 31 to 50 volts (100 to 150 D.C. watts). This capacity is sufficient to protect submerged areas up to 10,000 sq. ft. Preferred A.C. input is 110-3-60 but the unit can be equipped to take other A.C. characteristics. Step controls up to 50 D.A. with moving coil type ammeter and voltmeter are standard.

Further information on this new Cathodic Rectifier Unit may be obtained from the Trimount Instrument Co., 37 W. Van Buren St., Chicago 5, Ill.

CEMENT GUN COMPANY
"GUNITE" CONTRACTORS
GENERAL OFFICES—ALLENTOWN, PENNA., U.S.A.



DAM REBUILT WITH "GUNITE"

This is Lower Doughty Pond Dam belonging to the Atlantic City, New Jersey, Water Department, a poured concrete structure with fresh water upstream and tide water at the downstream toe. This structure became seriously disintegrated and eroded as shown in the left hand photo, and was completely restored with "GUNITE" a minimum of six inches in thickness with double mesh reinforcement.

The right hand view shows the finished job completed by us in 1941. Both the upstream and downstream faces were restored with "GUNITE," as well as the wing walls.

Our 72-page general bulletin C2300 describes this and scores of other uses of "GUNITE." We will be glad to send it to you upon request.

MANUFACTURERS OF THE "CEMENT GUN"

FIRST STEP TO IMPROVED EFFICIENCY

and Reduced Vacuum Filtration Costs.

Ferri-Cl3or
Ferric Chloride
The FAST Coagulant

THE MODERN COAGULANT

FERRIC CHLORIDE

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for Digester Heating
FOR RATINGS AND DATA SEE OUR PAGE IN THE 1946 ANNUAL REFERENCE SECTION
American Radiator & Standard Sanitary Corporation, Pittsburgh 30, Pa.
AMERICAN-Standard
HEATING PLUMBING
Serving the Nations' Health and Comfort
SALES OFFICES IN PRINCIPAL CITIES

for CONCRETE and STEEL!
Inertol
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Means Lowest Cost
Per Year
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GATE VALVE OPERATION
★ SAFE ★ RELIABLE ★ QUICK ★
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PIPE CLEANING PROBLEMS SOLVED
STEWART STANDARD WINDLASS
Frame. Sturdy angle iron construction. Cable drum holds 1100 ft. of 3/8" cable. Shipping weight without cable 250 lbs.
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NO. 11—SCREW NO. 22—SPEAR SCREW
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SYRACUSE, N.Y.

Pedrifugal Pumps

The Allis-Chalmers Mfg. Co., Milwaukee, Wis., announced a new line of "Pedrifugal" pumps. This new line of cast iron bronze-fitted pedestal type centrifugal pumps comes in three principal sizes, one inch by one inch, two inch by two inch, and three inch by three inch, with capacities from 10 to 500 gal. per min. at heads from 10 to 100 feet. Power requirements are from ¼ to 15 H.P.

The Pedrifugal pumps are designed for use with Texrope V-belt drives. Small and compactly designed, all sizes of the Pedrifugal pumps have essentially the same dimensions. The pumps may be operated in any position. This makes the unit suited for a large variety of uses.

Further information on the Pedrifugal pumps may be obtained from the Allis-Chalmers Manufacturing Co., Milwaukee, Wis.

Fischer & Porter Rotameters Become "Flowrators"

Fischer & Porter Co. of Hatboro, Pa., have announced a change in the name of its product from Rotameters to **Flowrators.**

Long manufacturers of the variable area type flow rate instruments called Rotameters, the company has announced its intention to change the name of this instrument because the name Rotameter fails to describe the function of the instruments and the fundamental operating equipment. The word Rotameter really suggests an instrument for measuring rotation, or one that measures by a rotating principle, and in addition the pronunciation of the word has been controversial.

The company hopes that the trademark name **Flowrator** will distinguish its products from all others and at the same time provide a more accurate term for area flow rate measurement instruments.

Lincoln Arc Welding Foundation Announces Contest

The Lincoln Arc Welding Foundation, Cleveland, Ohio, has announced the 1946 Design-for-Progress Award contest. Cash awards ranging from $100 to $13,200 will be made for papers or reports which cover the design or redesign of machines or structures, or operating a job weldery, or maintenance service, or research or education on welding.

There are 15 different classifications in which contestants may enter reports or papers for awards.

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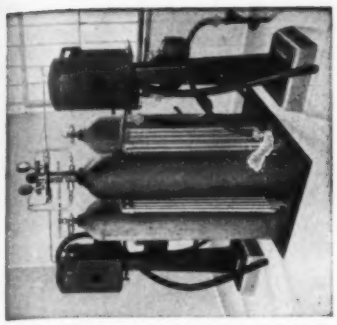

CHEMCO CHLORINATORS for MUNICIPAL INSTALLATIONS

The efficient, continuous, automatic operation of CHEMCO CHLORINATORS in municipal and private installations for nearly a quarter of a century is proof of their extremely high quality and dependability. Illustration shows a CHEMCO CHLORINATOR installation in State of New York Institution Sewage Plant. CHEMCO CHLORINATORS provide the answer in every type of installation where chlorination is necessary. Send for bulletins Nos. 300-1, 300-3, 300-5 for full information on exclusive CHEMCO features.

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Main Office & Factory: 1700 N. Main St., Los Angeles 54

REPRESENTATIVES IN PRINCIPAL CITIES

We know that there are many water and sewage plants throughout the country that utilize welding, particularly for maintenance purposes. Undoubtedly many of the men operating welding machines have ideas and practices that would be of interest to the welding field in general. If interested in this contest, they should write to the James F. Lincoln Arc Welding Foundation, Cleveland 1, Ohio, for further information.

LITERATURE AND CATALOGS

Steel Plug Valves

In a bulletin titled **a.c.f. Steel Lubricated Plug Valves,** American Car and Foundry Co., Valve Department, has presented a catalog of this type of valve. In addition to a cutaway drawing of the full-pipe area valve and the pressure-sealed balanced plug, the bulletin contains blueprints and general dimension data on a.c.f. steel lubricated plug valves ranging from 150 lb. class to the 300 lb. class of three-way valves. Round opening, venturi pattern, and four-way valves are likewise shown.

This type of valve is specifically designed for a range of temperatures and pressures exceeding the service limitations of semi-steel and bronze. The steel used conforms to the chemical requirements of steel valves.

Catalog No. S-46 may be obtained by writing the American Car and Foundry Co., Valve Dept., 30 Church St., New York 8 N. Y.

Large Capacity Pumps

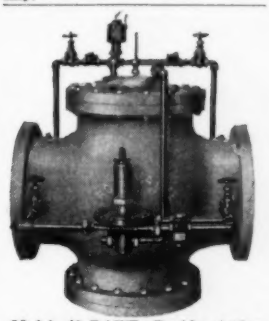
In Bulletin No. 148 of the S. Morgan Smith Co., **Pumps by Smith,** large, high capacity flow pumps are described. These pumps, which employ the automatically adjustable vane impeller axial flow, permit varying discharge by changing the pitch of the impeller vanes. This feature is especially advantageous and useful for conditions where low varying heads and high volume requirements prevail, such as are met in flood control, irrigation, sanitation, and many industrial projects.

The catalog contains sections on performance characteristics, control, cavitation, and construction details of the axial flow pump. A large tipped-in sheet shows adjust-

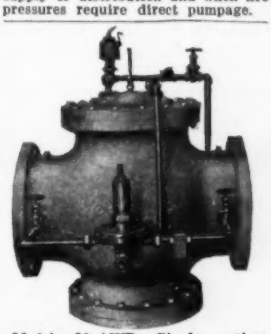
Est. 1879

ROSS AUTOMATIC VALVES

Altitude Valves for tank and reservoir, with two sets of controls—Automatic Hydraulic and Electric Remote Control. Hydraulic pilot normally operates the valve, while electric pilot is used for emergency only.



Model 40-DAWR Double Acting may be operated by electric pilot regardless of elevation of water in tank or reservoir, for a break in supply or distribution and when fire pressures require direct pumpage.



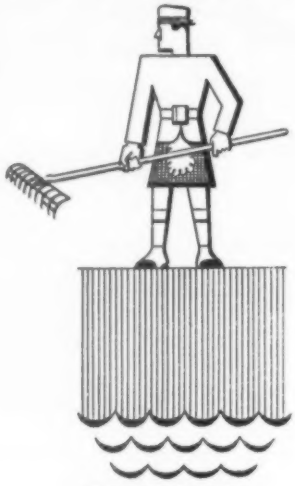
Model 30-AWR Single acting valve may be controlled in same manner as the Model 40-DAWR.

Model 40-AWR Single Acting semi-throttling valve will close on reversal of flow and the electric pilot would serve only a single purpose—either to open wide or close as emergency may require.

ROSS VALVE MFG. CO. Incorporated

P.O. BOX 595, TROY, N.Y.

RODNEY HUNT'S



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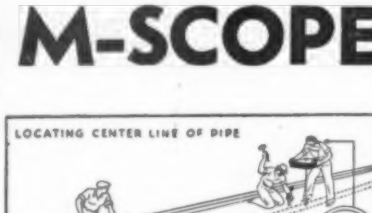
M-SCOPE



BURIED PIPE AND CABLE FINDER

16 PAGE BOOKLET FREE UPON REQUEST

FISHER RESEARCH LABORATORY

Palo Alto, California

able vane and fixed vane pumps. Details of the impeller hub and various settings are also shown, as are shop views of the building of the pumps and various installations.

The bulletin also contains a section on other products by Smith, including vertical stem motor-operated butterfly valves, manually operated conical plug valves, trash rack rakes, and impulse turbine runners.

The bulletin, "Pumps by Smith," may be obtained from the S. Morgan Smith Co., York, Pa.

Eye Protection

There are many places and many times in both water and sewage works utilities where protection of the eyes against accidents is of vital importance to the proper maintenance and operation of these utilities.

The Mine Safety Appliance Co. has issued a bulletin titled **MSA Eye Protection for Every Application** and this bulletin gives a complete assortment of eye protection equipment describing each in detail. Included are chippers' goggles, protective lenses, chemical goggles, open frame Ful-Vue spectacles, dust goggles, welders' goggles, and many other special goggles for special services.

The new bulletin also features the MSA Speedframe, a goggle mounting which eliminates troublesome hand adjustment, and Fogpruf for quick, efficient cleaning of lenses, as well as a Goggle Cleaning Cabinet.

A copy of the new MSA bulletin on eye protective equipment (No. CE-29) may be obtained by writing to the Mine Safety Appliance Co., Braddock, Thomas and Meade Sts., Pittsburgh 8, Pa.

Trash Rack Rake

Although it is designed principally for use in water power plants and pumping stations, the **Leonard Trash Rack Rake** undoubtedly could be used on intakes for water purification plants, or for that matter in sewage treatment works. These rakes are described in a bulletin under the above title, issued by the S. Morgan Smith Co.

The bulletin contains not only pictures of installations and operation of the rake, but data sheets on the design of the rake as well.

This bulletin No. 146 may be obtained from the S. Morgan Smith Co., York, Pa.

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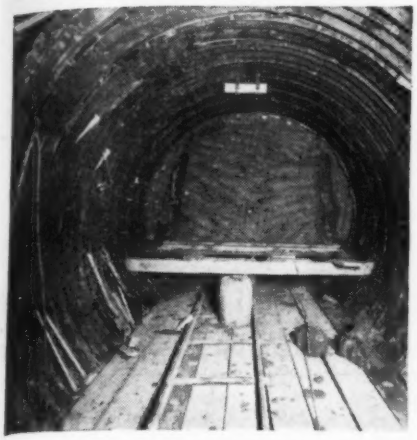

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You can forget about closed streets and the delays, hazards and inconvenience of trenching when you use ARMCO Tunnel Liner to install new sewers. The work moves quickly and economically and business above ground continues as usual.

Fast tunneling is the rule with ARMCO Liner Plates. Even inexperienced crews can install them quickly. One man easily handles the lightweight steel sections, bolting them together with regular wrenches.

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Power Generation and Distribution

In a 32-page bulletin issued by Allis-Chalmers Mfg. Co., Milwaukee, entitled **More Power to U. S. A.,** the company describes and portrays its products commonly used on generating, substation, transmission and distribution systems. Briefly, the bulletin presents A-C equipment available for power generation and distribution ranging from steam and hydraulic turbines, turbo-generators, engine type generators, condensers, and auxiliaries to pumps, water conditioning, motors, motor control, switchgear, circuit breakers, power and distribution transformers and unit substations.

"More Power to U. S. A.," Bulletin No. 25B6150, may be obtained from Allis-Chalmers Mfg. Co., Milwaukee 1, Wis.

Close-Coupled Vertical Pump

Where short pump settings are encountered and where there is a strong necessity for deep well turbine pump power and capacity in the field of industrial, municipal, engineering, and agricultural installation, the **Peerless Vertical Close-Coupled Turbine Pumps** may well be the answer. The pumps are described in a 20 page bulletin issued by Peerless Pump Division, Food Machinery Corp.

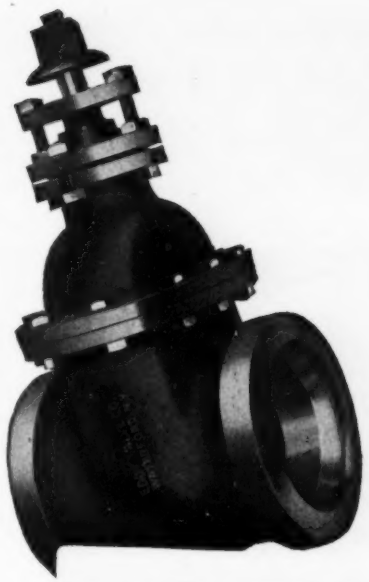
The bulletin is illustrated with cutaway views of the pump, schematic diagrams of suggested methods of pump installation in various services, and photographs of a wide variety of industrial applications. Details of pump engineering, construction and operation are described and illustrated.

These pumps generally employ for close coupled applications a shortened shaft and pump column with the necessary number of bowls and impellers to permit use in installation with short settings, such as pits, sumps, collecting basins, reservoirs, etc.

Copy of bulletin B-159 may be obtained from the Peerless Pump Division, Food Machinery Corp., 301 West Avenue 26, Los Angeles 31, Cal.

Durcopump Packing

If you have a Duriron pump you will want a new 4 page instruction folder titled **How to Pack Your Durcopump,** recently published by the Duriron Co. The booklet may be obtained by writing for Bulletin No. 813 to the Duriron Co., Dayton 1, Ohio.



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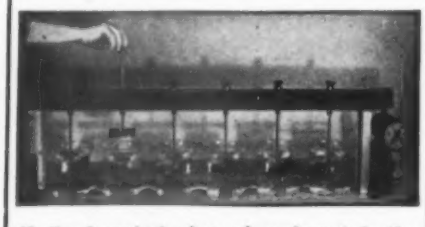

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FOR SALE—WATER AND SEWAGE SYSTEMS OF JERSEY HOMESTEADS PROJECT, ROOSEVELT, NEW JERSEY, NEAR HIGHTSTOWN, NEW JERSEY

Sealed proposals for the purchase of the water and sewage systems of Jersey Homesteads Project will be received until 2 p.m. January 15, 1947, and then publicly opened. Bids should be marked "Bid for Purchase of Water and Sewer Systems" and addressed in a separate envelope to the Federal Public Housing Authority, General Field Office, Attention Mr. Arthur M. Taylor, Room 408, Longfellow Building, Washington, D. C. The Government reserves the right to reject any or all bids. The properties are to be sold as a whole on an "as is" basis without waranty expressed or implied as to their condition or fitness for use.

These plants consist of the following items:

SEWAGE DISPOSAL SYSTEM

Screening Chamber
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Pump House Containing 2 raw sewage pumps
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2—40' circular rock filters with Door Co. circulators
Final settling chamber
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30,800 lin. ft. of 6", 8" and 12" sewer mains and 99 Manholes in place.
6" sewer connections to the 203 existing buildings and to 55 units where the foundations were laid before construction of the project was stopped.

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2 Wells—(a) One 10" in diameter is 444' deep and pumps 300 gallons a minute using a 10 HP motor driven 16 stage pump. (b) One 6" in diameter is 464' deep and pumps 85 gallons a minute using a 10 HP motor driven 16 stage pump. The 10" well spplies all the water needed at the present time. The 6" well is kept in condition by weekly operation tests.
Reservoir tank—75,000 gallons (with riser—84,500 gallons) with electric rust-proof control for interior including riser.
Settling tank—30,000 gallons.
Pump House containing 3 rapid sand filters.
Meters.
2 Booster pumps and various electrical controls
Aerator
Lime treatment room
2,000 lin. ft. of 1½" copper tubing
29,100 lin. ft. of 4",6" and 8" cast iron mains and 72 valves
26—6-inch fire hydrants
¾" copper connections to all buildings except the factory which has a 6" cast iron water connection and 55—¾" copper connections to the foundations. 6" and 8" drain overflow from wells each 150 ft. long terminating in concrete box water seals.

Prospective buyers are advised to visit the site and thoroughly acquaint themselves with the plant and equipment offered. The Government representative, Mr. Harry Glanz, Community Manager, Jersey Homesteads Project, Roosevelt, New Jersey, Phone Hightstown 449, may be contacted for personal inspection. The system as now operated has a net earning capacity of $2,300.00 with an anticipated ultimate net earning capacity of $6,400.00. It is to be sold with the understanding that the purchaser will provide continued water and sewer service at rates corresponding to those charged locally by other companies in this area.

All bids shall remain in force thirty (30) days from the opening date. Bids must be accompanied by certified or cashiers' checks payable to the Treasurer of the United States in an amount equal to 10% of the bid. This deposit will be credited to the purchase price if bid is accepted or returned if rejected.

Terms of sale will be a minimum of 25% cash, balance over not more than 5 years at 4% payable quarterly.

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No periodic oilings are necessary on this hydrant. The entire bonnet section is of dry-top construction as the water is sealed away from the operating mechanism by means of a stuffing box plate, packing gland and stem packing. But bearing surfaces need oil, so Mueller-Columbian Hydrants have an oil reservoir that keeps them continuously and automatically lubricated. This prevents corrosion of parts, insures easy operation and eliminates excessive wear...all important factors that mean operating dependability and lower maintenance costs.

This is just one of many outstanding features that have made Mueller-Columbian Hydrants preferred by leading engineers and water works men throughout the country. Investigate for yourself today by asking any Mueller Co. representative, or write direct.

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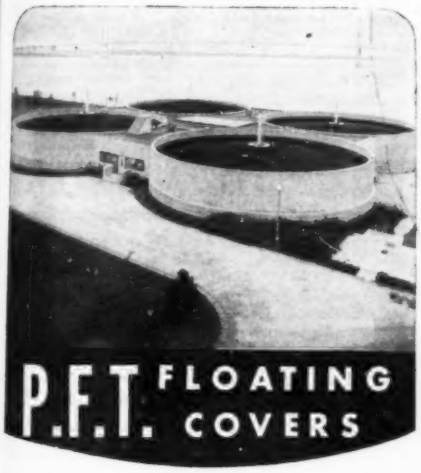

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One—1,000,000 Gallon Ground Storage Tank. 73 feet in diameter, 32 feet high. All-welded steel construction. Condition excellent. Built—1939. Department of Water and Sewers, City of Miami, Florida, P. O. Box 4821.

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Gould's 3-stage pump, direct connected to G E Motor. Figure 3330, size 5. Cap. 750 GPM, Head 350′. RPM 1750. #117,167. Induction Motor, Model #17,472, Type K T 543, 4, 100, 1,800. Form E three-phase, 60-cycle, volts 2,200, speed full load 1,750, amps 23.5. #4,404,575. HP 100, continuous 40 C. General Electric Co.
Price unit complete pump, motor and starter $1,000.00
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11,100 ft., more or less, of 12-inch "universal" cast iron pipe, collar and sleeve joint (bolted, not welded).
170 ft., more or less, of 6-inch cast iron "bell and spigot" pipe
4—6″ gate valves.
4—6″ check valves.
2—Centrifugal pumps, frg. 345,520 gpm. at 231 ft. head, Goulds, with 50 hp. Louis Allis, squirrel cage, Type EX, Class IE, 220-440 volt electric motors attached.
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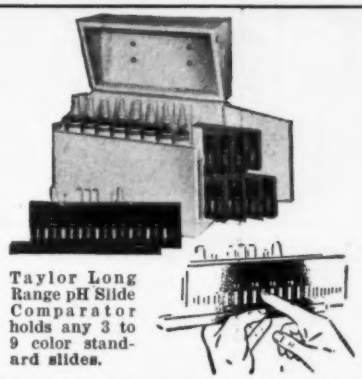

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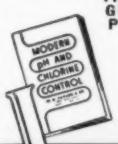

Many pages of "Modern pH and Chlorine Control" are of particular interest to water and sewerage works men. See your dealer today, or write direct to:

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Index TO ADVERTISERS

Albright & Friel, Inc. 114
Alvord, Burdick & Howson 114
*American Brass Co. 26
American Cast Iron Pipe Co. 27
American Concrete Pipe Assn. 32
*American Radiator & Standard Sanitary 108
*Anthracite Equipment Co. 112
Armco Drainage & Metal Products, Inc. 111
*Atlas Mineral Products Co. of Pa., The 31
Aurora Pump Co. 97

*Bailey Meter Co. 112
Baker, Jr., Michael 114
Betz, W. H. & L. D. 114
Black & Veatch 114
Bogert-Childs 114
Briggs Bitumen Co., W. A. 95
Buck, Seifert & Jost 114
*Builders Iron Foundry 95
*Builders-Providence, Inc. 95
Burns & McDonnell 114

*Calgon, Inc. 39
Camp, Thomas R. 114
Carson Cadillac 93
Carborundum Co. 35
Cast Iron Pipe Research Assn. 8-9
Cement Gun Co. 107
Centriline Corp. 87
Champion Corp. 97
Chapman Valve Mfg. Co. 42
Chemical Equip. Co. 109
Chester Engineers, The 114
*Chicago Bridge & Iron Co. 5
*Chicago Pump Co. 85
Clark Controller Co. 29
Climax Engineering Co. 33
Collins Engineering Co. 114
Cooper-Bessemer Corp. 38

Darco Corp. 104
Dean & Co., Payne 108
Dearborn Chemical Co. 28
De Laval Steam Turbine Co. 6
DeLeuw Cather & Co. 114
Diamond Alkali Co. 41
Dorr Company, Inc., The ..... Third Cover
Dresser Mfg. Co. 37

Eddy Valve Co. 111
Edson Corp., The 112
Electro Rust-Proof Co. 97

Fairbanks-Morse 16
Fay, Spofford & Thorndike 114
Fisher Research Laboratory 110
*Flexible Sewer Rod Equipment Co. 22
*Flexible Underground Pipe Cleaning Co. 22
Ford Meter Box Co. 103
Foxboro Co., The 90
Fulton, Edw. A. 114

Gannett, Fleming, Cordy & Carpenter, Inc. 114
General Chemical Co. 21
General Electric Co. 14-15
Gilbert Associates, Inc. 114
Gillette Pub. Co. 40
Glace, I. M. 114
Glauber Brass Mfg. Co. 91
Goff, Wm. A. 114
*Golden-Anderson Valve Spec. Co. 106
Gorman-Rupp Co., The 10
Greeley & Hansen 114
Grinnell Co. 94

Havens & Emerson 114
Hayden, Harding & Buchanan 114
Haydock, Chas. 115
Heilige, Inc. 113
Homelite Corp. 12
Hydraulic Development Corp. 106

Inertol Co. 108
*Infilco, Inc. 97
*Innis, Speiden & Co. 107
Iowa Mfg. Co. 110

Johns-Manville Co. 13
Jones & Henry 115

Kennedy, Clyde C. 115
Knowles, Inc., Morris 115

Lapp Insulator Co. 110
Layne & Bowler, Inc. 116
Leadite Co., The 106
Leupold & Stevens Instruments 102
Lock Joint Pipe Co. 11
Lozier, Inc., Wm. So 115
Lumenite Electronic Co. 95

Mathews Hydrants 4
Mathieson Alkali Wks., Inc. 25
Metcalf & Eddy 115
Meter Specialty Co. 112
Moore & Owen 115
Mueller Co. 113
Murray Laboratory 115

National Clay Pipe Mfrs., Inc. 23
National Technical Laboratories 89
*National Water Main Cleaning Co. 104
Neptune Meter Co. 44
Niagara Alkali Co. 19-20
*Northrop & Co., Inc. 112
Nussbaumer & Clarke, Inc. 115

*Omega Machine Co. (Division of Builders Iron Fdry.) 93

*Pacific Flush Tank Co. 113
Parsons Brinckerhoff, Hogan & Macdonald 115
Payne Dean Co. 108
Peerless Pump Division (Food Machinery Corp.) 92
*Pennsylvania Salt Mfg. Co. ..... Second Cover
Permutit Co., The 96
Philadelphia Quartz Co. 101
Phipps & Bird, Inc. 122
Pirnie Malcolm 115
Pitometer Co., The 115
Pittsburgh Equitable Meter Co. 3
*Pittsburgh-Des Moines Steel Co. 36
*Pittsburgh Plate Glass Co. (Columbia Chemical Div.) 7
*Proportioneers, Inc. 86

Regester, Robt. T. 115
Rensselaer Valve Co. 88
*Riddick, Thomas M. 115
Ridge Tool Co. 34
Robert & Co. 115
Robert Filter Mfg. Co. 96
Rockwell Mfg. Co. 3
Rodney Hunt Mach. Co. 110
*Ross Valve Mfg. Co. 109
Rossiter, Edgar A. 115
Roots-Connersville Blower Corp. 99
Roy Co., Milton 90
*Royer Fdry. & Mach. Co. 18
Russell & Axon 115

Sanequipment Engineering 106
*Simplex Valve & Meter Co. 93
Sirrine & Co., J. E. 115
Smith & Associates, Benj. L. 115
Smith Mfg. Co., A. P. 30
Solvay Sales Corp. 98
Stanley Engineering Co. 115
Stewart, M. C. 88
Stewart, W. H. 108
Streander, Philip B. 115

Tate Pipe Linings Co. 100
Taylor & Co., W. A. 113
*Tennessee Corp. 112
Thomson Meter Co. 44

U. S. Pipe & Fdry. Co. 17

*Vapor Recovery Systems Co. 24
Victaulic Co. of America 105
Virginia Smelting Co. 102
Vogt Bros. Mfg. Co. 102
Vogt Manufacturing Co. 102

*Wallace & Tiernan Co., Inc. ..... Back Cover
Warren Foundry & Pipe Corp. 100
Westcott & Mapes, Inc. 115
Weston, L. A. 88
Weston & Sampson 115
Whitman & Howard 115
Whitman, Requardt & Associates 115
Wood Co., R. D. 4

Zeolite Chemical Co. 112

*Advertisers with * were represented in the April, 1946, Convention and Data Edition with catalog specification copy. Please refer to that issue for additional information on behalf of their products.

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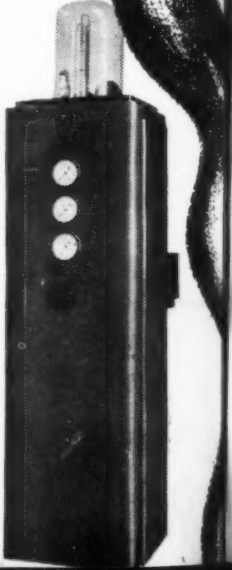

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